

NOV 20 1937

# Compressed Air Magazine

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November, 1937



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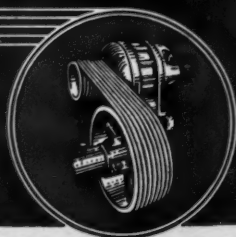
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M I L W A U K E E W I S C O N S I N

## ON THE COVER

THE aerial view includes approximately that section of Manhattan Island that was once New Amsterdam. It now constitutes only a small fraction of New York City, but its buildings exceed in average height those of any equal area on the globe.

## IN THIS ISSUE

DESPITE the fears entertained by many people, the awe-inspiring magnificence of Niagara Falls is not in danger of effacement, or even of diminution, for untold years to come. In fact, geologic conditions are such that the falls will probably grow higher for the next few centuries. However, steps are to be taken to retard the rate of recession and to augment the scenic charm of the cataract. The project is described in our leading article.

MODERN construction work moves so fast that we are scarcely given an opportunity to follow huge operations in detail. Apropos of this may be instanced the fact that the first stage of Grand Coulee Dam will be completed within the next few weeks. Already it contains more concrete than was placed in Boulder Dam, and the best pouring record made on the Colorado River structure has been surpassed by more than 50 per cent. The highlights of recent Grand Coulee construction are presented in an article by Henry W. Young starting on page 5460.

MUCH of Germany's internal commerce moves on canals. Ordinarily, differences in elevation are negotiated by means of conventional locks, but at Niederfinow this method slowed up traffic so much that a faster system became imperative. The result is a mechanical elevator that raises and lowers barges a vertical distance of 118 feet in 5 minutes. The article starting on page 5465 traces the history of such structures and describes in detail the operation of this latest and largest one.

IN West Virginia an entire town is being constructed preparatory to opening a new coal mine, and a 20-mile railroad line is being built to serve it. Excavating in West Virginian terrain calls for plenty of rock drilling, and in this respect the operations in question are no exception.

THOROUGH advance planning and careful selection of equipment enabled rapid progress to be made in placing a steel lining in Diversion Tunnel No. 1 at Fort Peck Dam to fit it for penstock service. Compressed air contributed to the operations in various ways.

# Compressed Air Magazine

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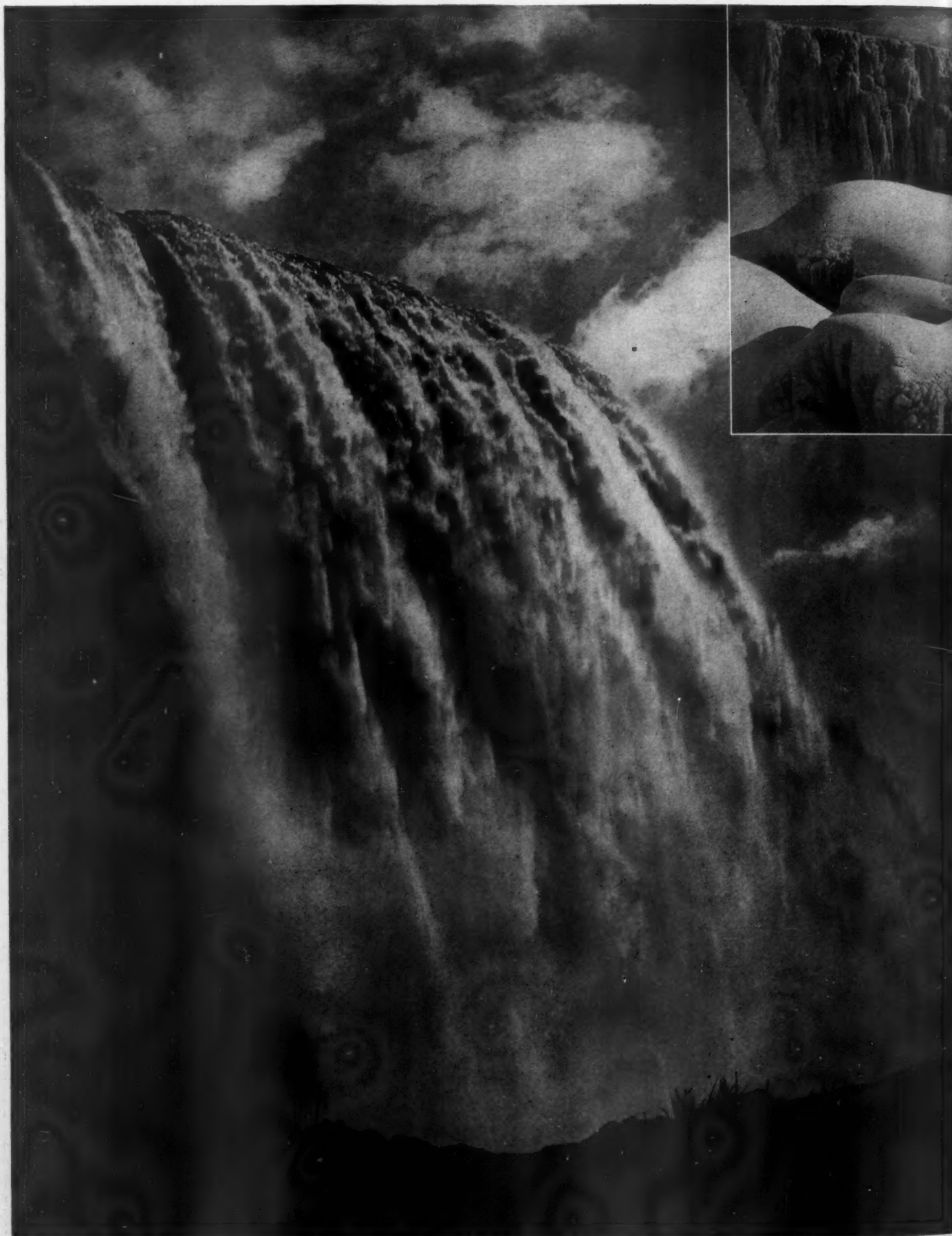
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#### THE MAJESTY OF NIAGARA

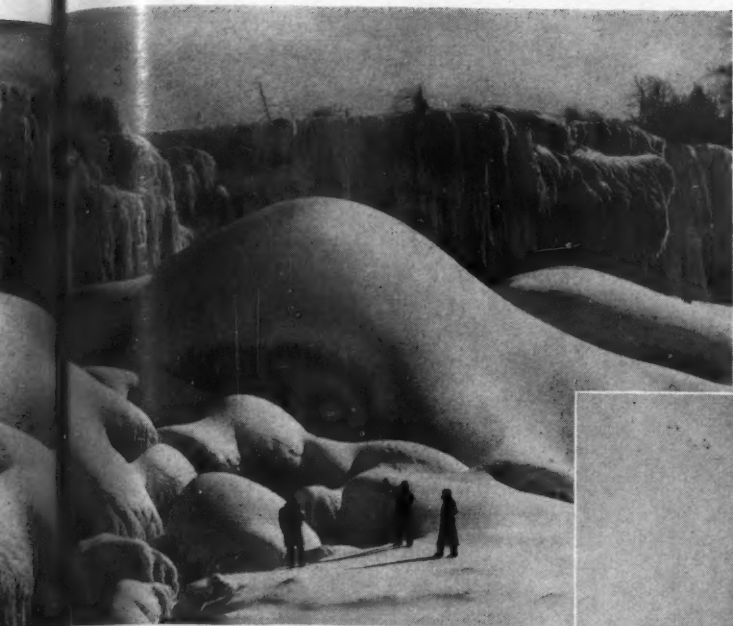
This picture conveys an idea of the tremendous power of the unharnessed falls. Even though about 34 per cent of the river's flow is diverted for various purposes, an average of more than 100,000 cubic feet of water per second passes over the two falls.

The hydro-electric plants that are operated with water taken from the river above the cataract develop about 1,500,000 hp. An additional 50,000 second-feet could be diverted, it is said, without destroying the magnificence of the falls.

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# Saving Niagara from Itself

Robert G. Skerrett



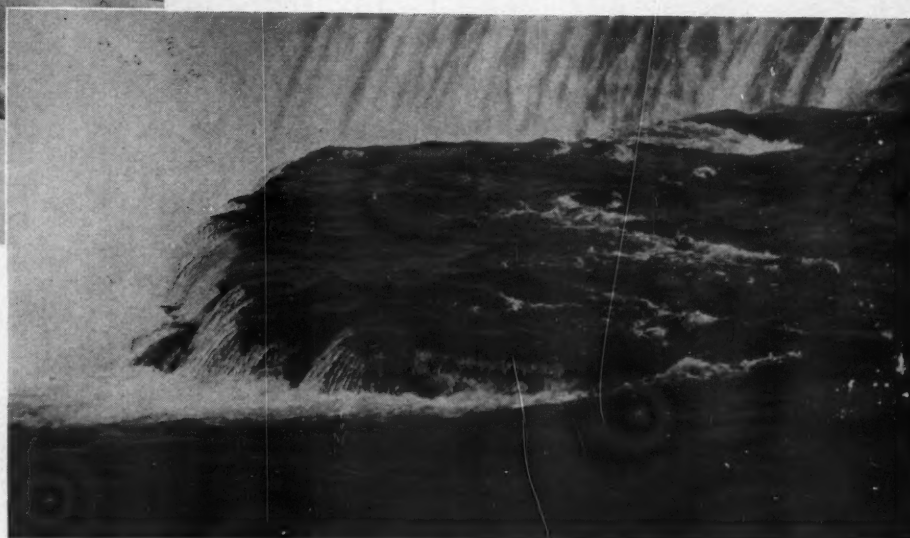
Ewing Galloway Photo

## IN WINTER GARB

**N**IAGARA FALLS, depending upon how one views the subject, may be dealt with either in the singular or the plural. In the singular, when looking upon the entire cataract as an example of stupendous natural forces still at work after untold ages: in the plural, when considering the spectacle as made up of two separate and contrastingly impressive sections—the American Fall and the Canadian Fall, with Goat Island intervening.

What concerns us now, however, is not a matter of grammar, but the fact that the scenic features of both falls are to be enhanced and, incidentally, the ravages of time arrested, as the geologist would probably say, for the moment. The beauty artists that are to tackle this big face-lifting task are not of the familiar order—they are engineers and constructors, especially such as are accustomed to the difficult and even dangerous job of carrying on in the midst of swift and violently flowing waters. At Niagara Falls the operations will be pursued at points only a short distance upstream from a sheer drop of more than 160 feet!

Niagara Falls for generations has been the most widely known and the most visited of our outstanding national wonders. During the last decade, an average of 2,000,000 and more persons have journeyed annually to look upon that tremendous spectacle; and in 1929 the visitors numbered in excess of 3,000,000. Father Louis Hennepin, a French missionary, is said to have been the first white man to see Niagara Falls. That was in 1678. He realized then why the Indians spoke of the cataract as the Thunderer-of-Waters, and declared that it had a drop equal to the height of the tallest of pines. In the interval of nearly 260 years, Niagara Falls has been made readily accessible; and both the Canadian and the United States governments have



Keystone Photo

## EVIDENCE OF WEAKNESS

The Canadian Fall, showing in the foreground the notch that has been gouged out in the crest line. In time, the block of rock that is being cut from the stream bed will become detached and drop.

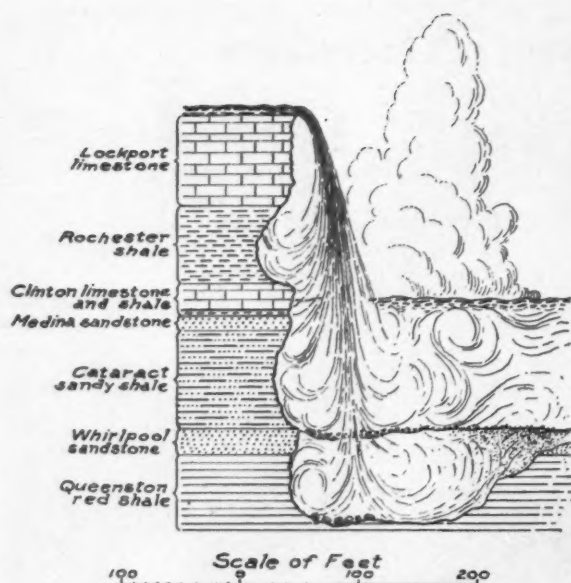
done much to make the immediate surroundings an appropriate international setting for that great scenic wonder. In the meantime, as in the long past, the Niagara River has been flowing ceaselessly seaward, moving the while the immense volume of water reaching it from the far-flung watershed of four of the Great Lakes. That water has continued to wear away obstructing rock and to promote the age-old recession of the falls.

Within the last few years, on several occasions, the erosive action of the rushing waters at the cataract has caused tens of thousands of tons of rock to break away from the crest lines of the two falls and to crash with the thunderous boom of avalanches at the foot of the precipice. Large as these dislodgments have been, gauged by ordinary standards of mass and weight, they have been but comparatively minor manifestations of what has happened repeatedly ever since the cataract began pouring over the escarpment, 7 miles downstream.

Since Niagara Falls started its magnificent recession, possibly 35,000 years ago, it has cut a winding gorge through layer after layer of differing sedimentary types of rock to depths ranging from 200 to 300 feet. Depending upon the control-

ling circumstances during the various stages of its 7-mile upstream retreat, the river has carved either wide or narrow gorge sections. The visible and invisible masses of rock in the bed of the Niagara, which are responsible for the stream's wild and splendid turbulence, remind us of what must have taken place recurrently on a grand scale throughout the ages that the Niagara River has been excavating downward and backward into the underlying formations.

Despite the gloomy prophets who become clamant whenever rock drops from the crest line of either fall, there is no reason to fear that the cataract is in danger of "committing suicide." Neither is there any likelihood that the falls will become just a succession of tumbling cascades—at least not for some thousands of years. There are ample evidences that the falls have undergone more or less pronounced changes in the last 200 or 300 years, but we need not let that alarm us. The greatest alteration of contour has occurred at the Horseshoe Fall since records have been made by careful observers. The rate of recession has been as much as 4.2 feet in a single twelve-month. Between 1842 and 1927 the mean annual rate of recession was 3.7 feet, and since 1905 it has been 2.3 feet. This reduction is no doubt largely due to the in-



Geological Survey, Canada.

#### WHY THE FALLS RECEDE

This vertical geological section of the Horseshoe Fall indicates graphically why the strata of softer shales and sandstones are worn away more rapidly than the harder limestones, thus undermining progressively the topmost layer of rock and causing some of it to drop from time to time. This action has been going on ever since the cataract was formed.

creased volume of water that has been diverted upstream of the falls since that date for power, navigation, and other purposes.

Both man and nature may influence in a marked degree the future rate of recession of the cataract as a whole, or the Horseshoe Fall in particular. The rate of the retreat will certainly be affected by the slope and the increasing thickness upstream of the hard limestone stratum that forms the immediate bed of the river. The surface of that rock has a drop of 50 feet toward the falls in the course of half a mile, and at its high point the stratum is about 130 feet thick. At the rim of the two falls it has a thickness of 78 feet. Therefore the river will have a more resistant rock mass and climb to negotiate in cutting the gorge farther upstream for a mile or more; and future generations will probably have a higher and more impressive cataract to look upon.

Many people wonder why the lip of the American Fall is virtually a straight line while the Canadian Fall is horseshoe in shape, inasmuch as the rock strata underlying each are the same in character and similar in thickness and arrangement. The explanation is that just above the upper rapids there is a ridge in the hard limestone of the river bed that dips toward the south and Canadian side of the stream. As a consequence, quite 95 per cent of the river's flow is directed toward the Horseshoe Fall over the lower part of that submerged ridge, and only 5 per cent finds its way to

the American Fall. Not only does a much diminished volume of water pour over the latter, but the islands in the rapids immediately upstream of that fall are instrumental in tempering the force of the currents and in bringing about a more uniform distribution of the water along its entire crest. While the curtain of the American Fall is thinner than that of the Horseshoe Fall, it is all the more beautiful because of its unbroken sweep and the general absence of an obscuring veil of mist. The American Fall has a drop of 167 feet—5 feet more than the Canadian, and its crest line is approximately 1,000 feet long while the curving rim of the Horseshoe Fall measures 2,600 feet.

The greater volume of water passing over the Horseshoe Fall is carried to its rim mainly through two channels that converge toward the apex of the lip; and it is this concentration that is responsible for the continually changing outline of the horseshoe. Latterly, the erosive action has cut a V-shaped notch that is deep enough to draw to it a larger proportion of the overflow. This has resulted in withdrawing enough water from the flanking wings to bare considerable areas of rock and in reducing the total spread of the curtain, to that extent impairing the scenic effectiveness of the Canadian Fall.

To diminish the flow at the apex of the Horseshoe Fall and to direct more of it toward the wings so as to flood the exposed areas, engineers are planning to use

submerged barriers or weirs that will virtually duplicate the rocky ribs which are the cause of the wildly swirling rapids on the slope upstream of the cataract. A longer transverse weir farther upstream, at what is known as the Chippawa Grass Island Pool, is projected to divert an increased percentage of the river's flow toward the American Fall so as to add somewhat to its picturesqueness. It will be understood, of course, that all the weirs are to be dimensioned and placed so as not to lessen the scenic character of the upper rapids.

The Special International Niagara Board that was called upon to decide what should be done to preserve and to improve Niagara Falls and the associate rapids, wisely sought the aid of various experts in analyzing the problem and in determining how far man should go in tampering with what nature has done in creating the titanic spectacle as it is today. The first question to be settled was just what constitutes the scenic beauty of the cataract as a whole. This may seem a simple thing to do, but it proved somewhat complex because of a lack of unanimity of opinion on that point. Some declared that it was dependent upon the volume of flow; others, that the height of the falls was their most spectacular feature; still others, that most of the beauty was due to unbroken crest lines; not a few—reacting like the ancient Indians—emphasized the awe-inspiring effect of volume of sound; while artists, psychologists, and





Ewing Galloway Photo

### PANORAMA OF FALLS

A view from the Canadian side of the Niagara River, showing the American Fall on the left and the Canadian or Horseshoe Fall on the right, with Goat Island between them. Only about 5 per cent of the river's flow normally passes over the American Fall.

kindred specialists attached much weight to color effects and to the contrasting vertical, parallel lines of green and white water which give the appearance of both depth and height to the tumbling curtains.

All the consultants recognized that the falls should be considered in their entirety, with due regard to the scenic setting. Carefully made measurements of color, of volume of flow essential to give satisfactory results, and of the depth of flow needed at the crest lines revealed that a large reduction in the volume of the river's flow would leave the spectacle undiminished. In fact, it was the opinion that such a reduction would help to retard further erosion at the Horseshoe Fall. From this one can infer that the international board viewed its problem from both an aesthetic and an economic angle, because all water not required to maintain the cataract's scenic effectiveness can be put to service in generating a still greater block of hydro-electric energy. We are told that an additional 50,000 cubic feet of water per second could be diverted without robbing the upper rapids and the falls of their magnificence.

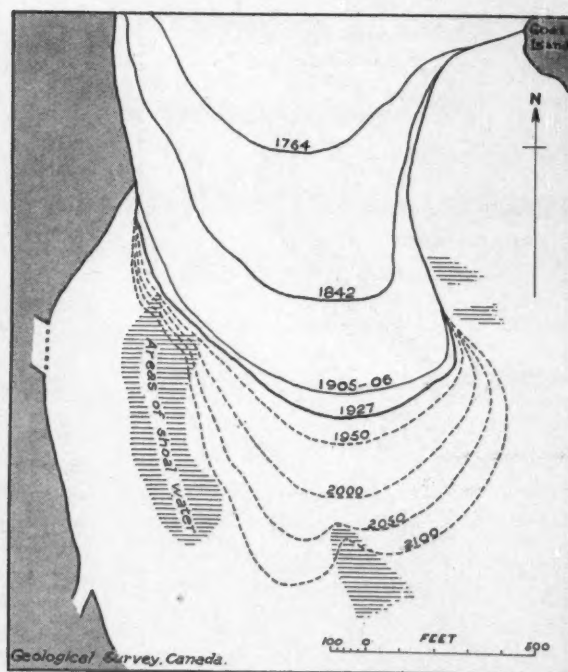
Contrary to general belief, the recession of the cataract is not the direct result of

the wearing away of the rock which forms the bed of the river and the rim or crest lines of the falls. That stratum of hard and resistant limestone rests upon strata consisting mainly of much softer sandstones and shales, with a thinner layer of Clinton limestone interposed at about the level of the pool at the foot of the cataract. It is the undermining of the softer sedimentary strata by the plunging waters and the solid matter carried by them that progressively erodes the top layer composed of Lockport limestone and leaves sections of that crest rock projecting without sufficient underpinning and yet subjected to the load of the overrushing river. This rock has cross seams, and where unsustained successively breaks free in blocks of varying sizes that drop into the pool below. In the case of the American Fall, much of this rock has landed on a protruding lip of the Clinton limestone and has formed a buffer upon which the pounding water strikes and is deflected outward and away from the rocky palisade, thus lessening greatly the erosive attack upon the strata of sandstone and shale. The Horseshoe Fall, on the contrary, has no such protecting glacia, and, in consequence, the soft rocks both above and below the surface of the pool are exposed to relatively rapid destruction. Now we know why the Horseshoe Fall is intermittently undergoing a change in the contour of its crest line and why it is retreating upstream at a faster rate than the American Fall.

In the foregoing manner the cataract as a

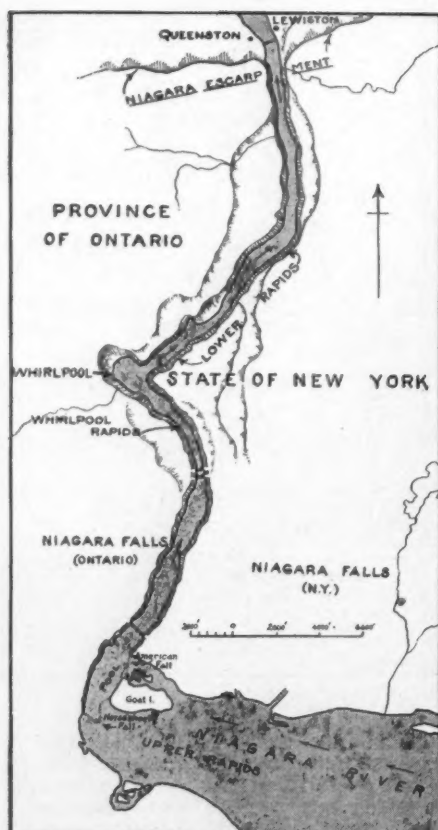
whole has receded southward continually, although probably at widely different rates, ever since it first tumbled over the escarpment adjacent to the present towns of Queenston and Lewiston on the Canadian and the American side of the river, respectively. In this march upstream the cataract is said to have taken 3,000 years to advance the last 12,000 feet; and, unless conditions alter the river's habit, Niagara Falls may some day in the remote future arrive where Buffalo now stands. When that comes to pass, the level of Lake Erie will drop to approximately that of Lake Ontario, in that event doing away with the 326-foot difference in elevation that exists today. In any case, geologists assure us that it will take not less than 2,000 years for the Horseshoe Fall to recede far enough to divert all the river's flow to it and leave the American Fall high and dry. This should be of some comfort to those pessimists that hearken to every announcement of the approaching dissolution of our most popular natural wonder.

Having accepted the fact that Niagara Falls is established for a long time to come, we can turn our attention to the remedial measures that are to be taken to retard further deformation of the magnificent sweep of the Canadian Fall. Just how the submerged weirs are to be built will be left largely to the men who are to do the work. Whether they will be erected within areas unwatered by the use of cofferdams so that they can be lastingly anchored to bed



### RATE OF RETREAT

The heavier contour lines show the recorded positions of the crest line of the Horseshoe Fall at various intervals, and the dotted lines indicate the assumed positions between now and the year 2100. For a long time to come the recession will be retarded by the upstream slope of the limestone stratum that forms the stream bed and also by the increasing thickness of that band of comparatively hard rock.



#### EXTENT OF MOVEMENT

The upstream movement of the falls has progressed for a distance of 7 miles, in evidence of which there is the deep gorge in the river extending from the original location at the Niagara Escarpment to the present site. Geologists estimate that this recession has taken possibly 35,000 years. The cataract is still retreating southward toward Lake Erie.

rock, or whether cableways suspended across the river will be utilized to sustain working bases directly above the waterway, will be determined later. Along the wings of the Horseshoe Fall, where the river bed is bared, boulders as well as some ledge rock will be cleared away to provide unobstructed areas for the wider spread of the flowing water. Air-driven rock drills will have their full share in bringing about this physical transformation, as they will enable the excavating to be done both effectively and rapidly. Perilous as the undertaking may appear, except for the added hazard presented by the nearness of the falls and their great sheer drop, operations of a similar character have been successfully brought to completion time and time again. The contemplated work will call for an expenditure of about \$1,750,000. However, this may be increased should circumstances warrant the building of additional structures or modifications of those now projected.

Undoubtedly, Niagara Falls may impress the majority of people by reason of its magnitude and the awe inspired by the stupendous power in the flow of the tremendous volume of water that pours ceaselessly over the cataract. But back of that

spectacle is the amazing record, laid bare in and about the gorge, of the geological story of this continent and of the conditions that brought Niagara Falls into being and that have affected the course and habit of the river during an estimated period of 35,000 years. The river, like a surgeon's knife, has cut deep into successive layers of sedimentary rock, disclosing the inner secrets of the crust of the earth and giving us physical evidences of what happened in the Paleozoic Age—perhaps even more than 500,000,000 years ago.

In the gorge below the cataract, the Niagara River has carved its way through what was once the bed of an immense warm inland sea above which moved the air of a semitropical climate. In the Rochester shale, immediately below the crest rock of the falls, have been found the fossil remains of trilobites and other ancient forms of primitive life that flourished during the earlier part of the Paleozoic Age, a single era in geological time that is estimated to have lasted for 345,000,000 years. A vertical section of Niagara Falls, reaching down to the bottom of the pool at the foot of the cataract, includes six other sedimentary strata that must have been deposited slowly and over protracted periods ages before the Rochester shale was laid down. As fascinating as the subject is, we must jump to a relatively modern era—the Ice Age of 1,000,000 years ago—which no doubt had the most direct bearing upon the creation of the Niagara River and, subsequently, the birth of Niagara Falls.

Before the advent of the Ice Age, much of the vast area that had formed the bed of the warm inland, saline sea was uplifted high into the air by the balancing forces that incidentally pushed the invading ocean outward toward the Atlantic coast line to be. The cloak of ice that spread south and westward from the crowning center in Labrador over and beyond the region of the Great Lakes is said to have had a vertical thickness of a mile and more. The enormous weight of that frigid mantle was sufficient to depress the underlying crust of the earth many hundreds of feet; and during the advance and the subsequent retreat of the ice, underlying sedimentary strata were pushed hither and thither and upheaved as by titanic plows. Also, immense masses of rock were broken loose from their primordial bodies, shifted great distances, or ground down or possibly pulverized as the ice moved irresistibly onward. The face of the region so exposed was transformed well-nigh like a modeler's clay—valleys were filled with glacial drift or passages gouged where none before had existed.

Conversely, as the ice cap retired, the relatively resilient crust of the earth reacted and lifted, bringing into being new hills and other confining ridges that formed the boundaries of valleys and basins in which could be held the water from the melting glaciers and the precipitation from the skies. Expanses of water—lakes, great and small—came into being, and either disap-

peared or remained with varying contours and depths as the retreating ice or the readjusting earth afforded or limited outlets to the water seeking the level of the sea. These changes are, in part, clearly indicated by the course, the depth, and the width of the gorge of the Niagara River. The waters that occupied the post-glacial basins during the formative period of the Great Lakes did not, as now, use the Niagara River alone or at times at all as a channel to the sea; and even when that river became an artery in the system, it alternately served as an outlet for several or only one of them in passing the water seaward via Lake Ontario.

The Whirlpool, 2 miles below the falls, was undoubtedly an earlier cataract when the Niagara River traced a different course from that point and made a sweeping westward curve on the Canadian side, rejoining the river, as we know it today, a few miles before reaching Lake Ontario. The deep gorge cut by that ancient detour was obliterated by glacial drift. There is evidence that the Great Lakes system also had an outlet to the sea via the Mohawk-Hudson route, with a cataract to the eastward of Syracuse as imposing in all its features as the Niagara Falls we now admire. The distance between the latter and the site of the Syracuse cataract, which was also an immense horseshoe, was about 150 miles.

Absorbing as the subject is, and deserving of detailed treatment, we shall have to limit ourselves to just the outlines of what has occurred since the primordial days of Niagara Falls. The progressive retreat of the glacial burden and the subsequent topographical changes and uplift led to fluctuations in the volume of water carried by the Niagara River—the diminution being as much as 85 per cent as other channels of relief were offered certain of the upper lakes. These periods were four in number and of indeterminable lengths before the final act of this great geological drama took possession of the stage. The dimensions of the different sections of the Niagara Gorge are indisputable evidence of the various dominating periods. The fifth act is the present one, which has been 3,000 years in unfolding. During that time the Niagara River has scoured out the glacial drift that was in the Whirlpool, has used that abrasive material in cutting the wide gorge below the Whirlpool, and thereafter has pursued its course in advancing the cataract to the site it now occupies.

The whole Great Lakes region is still reacting to the compression of the last glacial invasion, and the earth's crust throughout the vast affected expanse is lifting northward and increasing the general slope southward. How far this may influence the flow and the course of the Niagara River are subjects of speculation; but the trend is more or less continuous. We must remember that time in such matters is measured by a geological clock that registers its periods in thousands of years instead of our accustomed minutes.

# Coulee Dam Foundation Nears Completion

Henry W. Young



## SCOURING SQUAD AT WORK

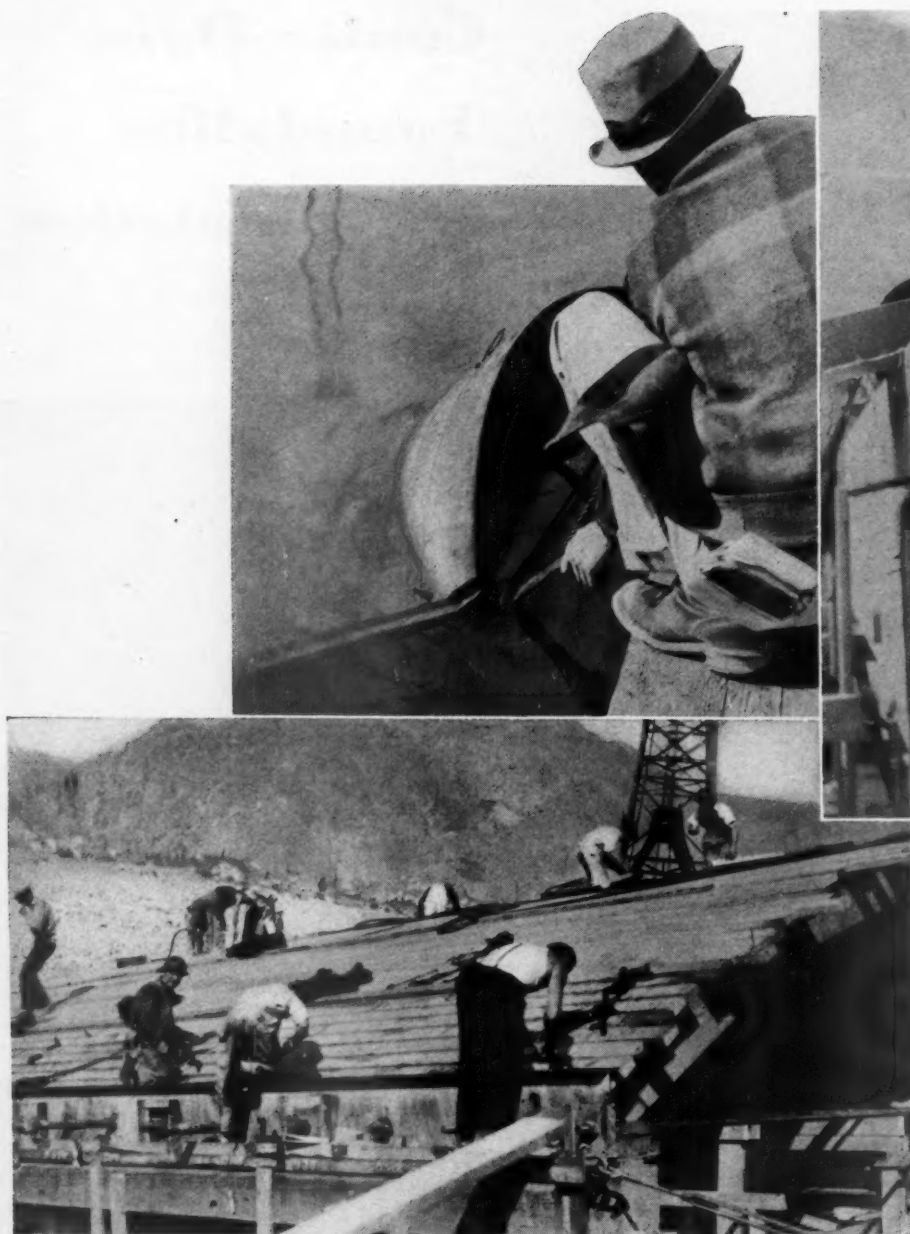
The concrete is poured in 5-foot lifts, and at least 72 hours must elapse between the pouring of successive lifts. During that interval the horizontal surfaces are covered with sand, which is kept wet. To insure a good bond between the concrete in place and that poured on top of it, the surface must be cleaned scrupulously. This is accomplished by scouring it with powerful sprays and wire brushes. The streams of water shown here reach the nozzles under pressure, and at that point are given an added force by the admission of air at 90 pounds pressure.

ONE year ago the writer visited Grand Coulee Dam and reported (December 1936 issue) that his first impression was that there had not been much visible change since he first inspected the project fourteen months before. A third trip was made in September of this year. What was found? Merely that the 177-foot-high foundation dam is nearly finished. The contractors—Mason, Walsh, Atkinson, Kier Company—expected to be through in December of this year, sixteen months ahead of schedule. The transformation that had taken place in the meantime was most remarkable. No high water was in prospect as in 1936, and even if there had been, no one would have cared. All the work was well up out of the old stream bed. The outlet tunnels and a few low gaps in the dam could take away at least twice as much water as has ever flowed there since records were kept. During periods of low water, the tunnels alone would suffice. Already, the U. S. Bureau of Reclamation was getting ready to ask for bids on the construction of the upper part of the dam to its ultimate height of 550 feet for irrigation purposes.

What this great change amounts to can best be gathered from the general view on

page 5462, which was taken about the first of September. The camera was set up near the site of the pumping plant, which will eventually lift the water from the pool back of the dam over and into the balancing reservoir in the Grand Coulee. The ledge in the lower left-hand corner is one of the steps of the pump-house foundation, which is carved out of the solid granite. In the same part of the picture is seen the west end of the foundation dam which, with the exception of some gaps that will soon be filled in, has been nearly poured to its full

height. In the middle is the main-river diversion, which was accomplished in January of this year. The cell clusters on the right connect with the upstream cross-river cofferdam. To the left of them is the great bucket timber crib, and beyond that the downstream cross-river cofferdam running off at an angle. Along the dam line, where the steel trestles are still exposed, concrete was then being poured at a record rate. This is the midstream area over which the river formerly flowed, and still farther on is the excavated area on the east side.

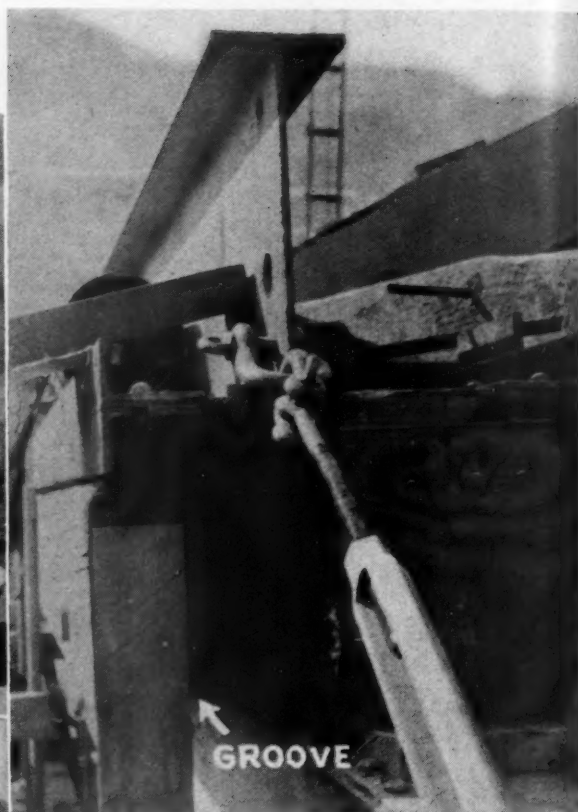


#### BUILDING CLOSURE GATES

Slots left in the dam (see picture on following page) to pass flood waters will be concreted to full height. To permit this, their ends will be closed with timber gates that will be floated into position and held there by the pressure of the water. Immediately above is one of these gates in course of construction with the aid of air-operated tools. The view at the upper right shows the end of one of the edges of a gate. The undersides of the square timbers will rest against the vertical face of the dam. A groove may be noted in the left-hand timber. In this will be laid a flat canvas hose, and across it, the length of the timber, will be fastened a strip of rubber. After the gate is in place, the hose will be inflated, thus pressing the rubber into irregularities in the concrete and forming a watertight seal. Air tanks are included in the gates to give them the desired degree of buoyancy. In order to determine just how these gates will float, a model was constructed and tried out. It is shown at the upper left floating at an angle in the water, in which position it can be readily placed upright against the face of the dam.

At the time the photograph was taken, the bare section in the right foreground was in reality a steep earth slope that had been more or less of a menace all along because of the contained moisture that might cause it to slide. A small pumping plant near the middle had been at work there much of the time. The writer had not much more than arrived at Grand Coulee on September 20, in the midst of the dry season, when this bank decided at

last to slip. With little noise, but a cloud of dust, it slid down to the very edge of the dam, leaving a straight drop at the upper edge of approximately 50 feet. About 1,000,000 cubic yards of material was involved. No harm was done, for the area will eventually be underwater anyway, and the dam was too far along to be damaged. To the right of the far end of the trestle, in the upper part of the picture, is the area where a slide occurred last

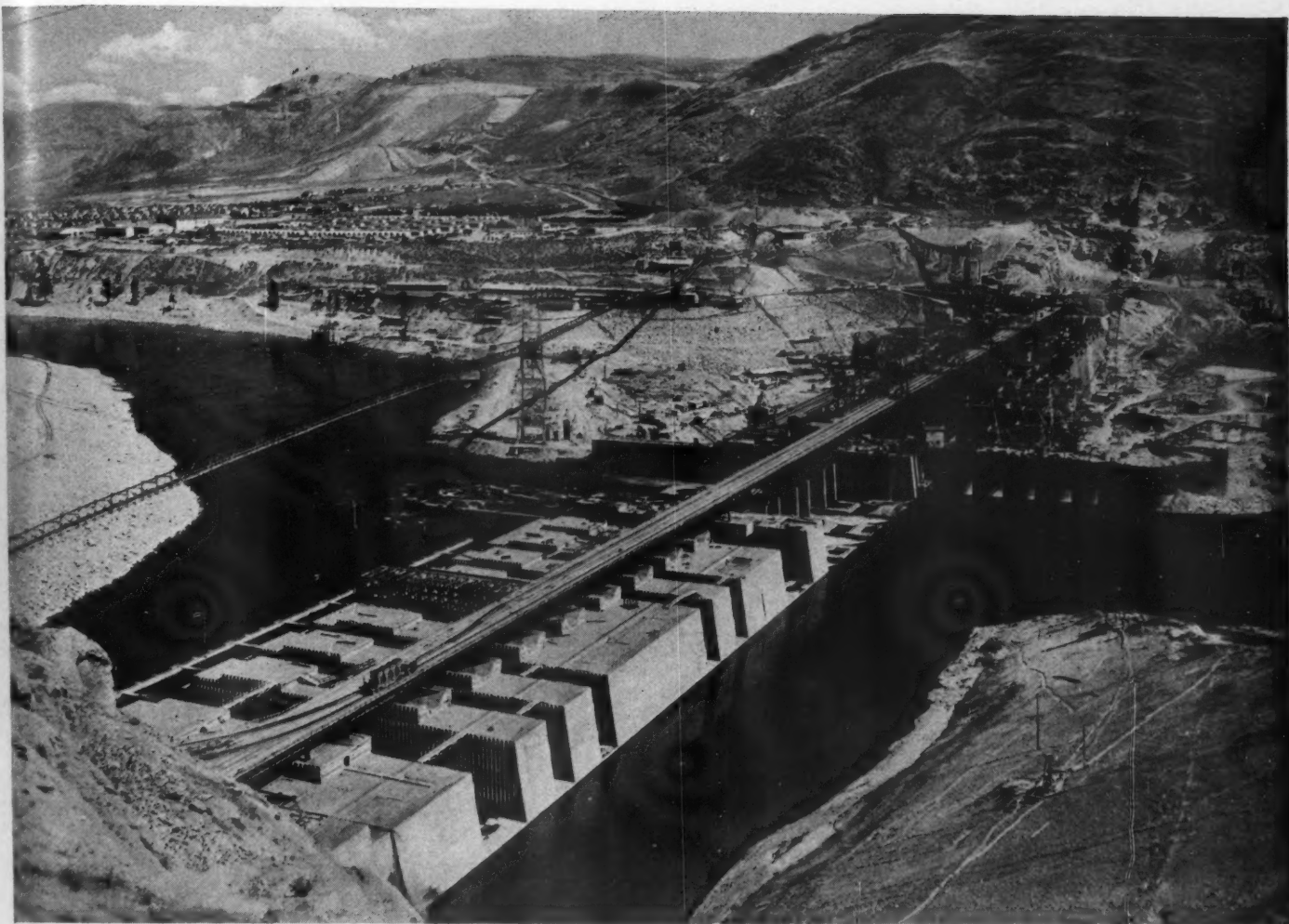


year. As was described in the December, 1936, issue, the toe of that slide had to be frozen to hold it.

Looking down on this view, it is hard to realize the amount of excavating that had to be done before the work of dam building could go on. Up to June 25, 1937, there had been removed at and near the dam site, together with the camp site, highways, etc., a total of 20,030,708 cubic yards of common material and 1,477,000 cubic yards of rock. This is exclusive of the gravel-pit operations far up on the hillside near the top center of the picture, where 9,000,000 cubic yards had been taken out.

Practically all the excavating had been completed on that date. There remained only about 15,000 cubic yards of general material and less than 100,000 cubic yards of rock, the latter in the east abutment, at the pump-house site, and a little under one section of the toe of the spillway. As seen in one of the photographs, 20 Ingersoll-Rand S-49 Jackhammers were in operation on this last-mentioned belated piece of rock work in the shadow of the great timber crib and adjacent to the already poured concrete of the spillway. A ticklish piece of blasting was involved, and great caution had to be observed not to disturb the rock foundation under the dam. There was also the crib to be considered, as well as valuable fixed equipment almost overhead.

In explanation it may be said that a serious leak developed last March in a sand seam under the "G" cell cluster connecting the timber crib with the downstream cross-river cofferdam. The inflow reached a maximum of 30,000 gpm. The water was coming in under the big "G" cell, and an attempt



#### AS GRAND COULEE DAM LOOKED IN SEPTEMBER

Since this picture was taken, concrete pouring has been going on at a rate approaching 15,000 cubic yards daily, and many of the gaps have been filled to levels higher than they are here. The barren area in the right foreground has also changed

in appearance, as more than 1,000,000 cubic yards of earth in that section slid down against the face of the dam. No harm was done, however, as this area will all be underwater when the reservoir fills.

was made to check it by boring holes down to the sand seam through the sodden earth inside, and by pumping in grout under air pressure. It was hoped that this would spread out and close the seam, but the effort was only partway successful.

The method finally employed consisted of putting down across the corner a ring of steel cells and of sealing the whole section with various materials, including bentonite, sawdust, shavings, portland cement, etc. This stopped the leak, but left four of the "R" cells, as they were called, standing on rock under what was to be the toe of the spillway. Therefore, it was necessary to leave an area of roughly 100x200 feet for later excavation to a depth of about 24 feet.

The rock was loosened a little at a time to a depth of only 10 feet in each of two lifts and 4 feet in a third. Approximately 100 holes were drilled and shot at once, starting in the corner next to the dam and farthest from the crib. Ten of these were shot straight and the others in groups of ten with nine delays, using about five sticks of Hercules 25 per cent gelatin in each hole. With each blast there would be a little

rumble and a puff scarcely to be seen a few hundred feet away, but when it was over the rock was found to be thoroughly broken so that it could be loaded into trucks with a Marion 4141 electric shovel with a 5-cubic-yard dipper. The first group of shots left a narrow ledge on the outer edge of the area, and this required from 70 to 80 holes for its removal. In this way the workers proceeded to the crib. The material was very hard granite, and only about 2 inches of penetration per drill bit could be obtained before there was need of resharpening.

After the river had been diverted and the east-side construction area had been pumped out, the bedrock was exposed and all the surface rock excavated to a depth of 8 or 10 feet to sound rock. It was then that a gorge, some 40 to 70 feet wide, was revealed in the center section. This had to be drilled and blasted to a depth of 80 to 90 feet below the general bedrock level in order that no vestige of a seam might remain. This delayed the extension of the two ends of the concrete-placing trestle, thereby reducing the rate of concrete pouring because of

the difference in elevation between blocks. In consequence of these curtailed operations, there was little demand for a time for the output of the west-side mixing plant. However, the east-side mixers offset this in part by making record runs, one reaching 9,290 cubic yards in 24 hours. This compares favorably with 10,642 cubic yards at Boulder Dam with two plants running.

As will be gained from the foregoing, the sounds of pneumatic Jackhammers and drill sharpeners have about ceased at Grand Coulee. The rock phase of the work is practically over. The remainder of the present contract, and all those to follow for the purpose of building the dam to its ultimate height, will consist of the more or less routine job of mixing concrete and pouring it in blocks one on top of another. Even so, compressed air will continue to be extensively used for pumping cement long distances, for operating concrete mixers, in the aggregates plant, etc. Besides, some new applications of air will arise from time to time. All the equipment for these various services will be taken over by the Government at a nominal figure after the



#### A MINIATURE CANYON

Exploration of the bedrock underlying the stream channel, bared after the river was diverted, revealed the presence of a seam of soft material. It varied from 40 to 70 feet in width and persisted to a depth of more than 80 feet. The picture shows the gorge that was created in excavating it. After being drilled

and blasted, the material was hoisted in "stone boats," one of which is shown. This operation delayed concrete pouring in the mid-dam section, as the trestle from the mixing plants on either side of the river could not be extended until the excavating had been completed.

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completion of the foundation dam and will be turned over intact to the succeeding contractor.

One recent use of compressed air is interesting, although of minor importance as to volume. It is in connection with the four closure gates that will be required to shut out the water at the upstream and downstream ends of the slots in the dam so that the openings may be concreted to full height. These slots, of course, have been left to carry off excess water during construction, and will be closed one or two at a time. The gates are timber structures that were carefully carpentered on the river bank, and will be launched and towed into position. Each is 50 feet high by 56 feet wide, weighs 26 tons, including a concrete slab across the bottom, and will be placed upright at one end of a slot, spanning it sufficiently so that its edges will rest against the concrete surface of the dam. The outer face of the gate, which will be exposed to water pressure, is slightly curved.

The edges of each gate consist of a 16x18-inch and a 14x16-inch timber, bolted together side to side and reinforced with a heavy I-beam construction, as shown in the detail view of one end. The under edges of the timbers are to rest against the dam. By looking closely, a groove may be seen in the under face of the outer timber. And here comes the unique compressed-air application. In this groove is a length of linen fire hose, and across it a wide strip of rubber held down by flat-headed wood screws. When the time arrives to put the gates in position, each will be floated to one end of a slot and will be placed across that opening with its edges, as has already been mentioned, resting against the concrete. With both ends thus closed, the water inside the slot will be pumped out—the pressure of the water outside holding the gates against the face of the dam. But, even so, the joints will not be watertight because of irregularities in the concrete surface. Therefore, compressed air from the 90-pound air lines will be admitted to the hose sections just as air is admitted to the inner tube of a tire. This will cause the rubber strips to bulge outward and completely to seal the joints.

Compressed air will also be used to float the gates into position. Three steel tanks are mounted inside of each structure—one 25x5-foot unit horizontally across the lower end and two vertical ones, each 5x8 feet. These are piped so that air can be pumped in or out to expel or to admit water, thus making it possible to shift the structure to be towed at an angle through the water, and to increase or to lower its buoyancy so that it can be floated into its proper place against the face of the dam. As it was a little hard to determine just how the gates were going to float, a model was made to scale with correctly proportioned air cylinders.

In another illustration, men appear to be washing concrete with a hose, but the process of cleaning is much more thorough than



#### FINAL DRILLING FOR SPILLWAY

Twenty S-49 Jackhammer operators, looking very small against the huge timber crib of the cofferdam, are seen here taking out the last of the rock left at a point where a section of the toe of the spillway will be. In stopping a leak beneath one of the cell clusters it was necessary to erect structures on this site, and its excavation consequently had to be delayed.

that. The streams issuing from the hose are water combined with 90-pound air, the jets being controlled by special nozzles. The reason for this thoroughness is to be found in the specifications, which prescribe the following rules for placing the concrete:

The concrete is to be laid in 5-foot lifts. There must be a 72-hour minimum interval between the pouring of successive lifts.

All concrete must be kept wet a minimum of fourteen days.

Every concrete surface must be cleaned thoroughly, so that bare sand and gravel are exposed, using wire brushes and powerful sprays.

During the three days or more in which the concrete is setting, the upper surfaces are covered with sand, which is kept wet. When a new lift is to be added, the sand and calcium carbonate from the cement are removed with the sprays, as seen in the picture. After that, all water is sopped up with a sponge. If, in getting someone ready for an operation, the nurses and doctors cleanse all parts as carefully as this concrete is cleaned, the patient should come out fairly well.

The following supplemental material concerning progress at Grand Coulee Dam is extracted from the October issue of *The Reclamation Era*, published by the U. S. Bureau of Reclamation:

In mid-September, 3,500,000 cubic yards of concrete had been placed in the dam, and new world records for the rate of pouring had been established numerous times. The greatest quantity placed in one day was 15,600 cubic yards, or nearly 50 per cent above the best mark attained at Boulder Dam. It is expected, however, that as much as 17,000 cubic yards will be poured in a 24-

hour period before the present contract is finished.

Cement is now being received at the rate of about 95,000 barrels a day from six plants in the State of Washington. Up to September 1, deliveries amounted to 15,295 carloads, or enough to make a train 142 miles long. From the blending plant, high on the west-canyon wall, the cement is forced by compressed air through 11-inch pipes to the mixing plants, one 2,000 and the other 6,200 feet distant. Through one of these lines, half a trainload of material crosses the Columbia River every day on a suspension bridge.

Gravel for concrete is dug from a huge pit by electric shovels at the rate of 30,000 cubic yards a day. It is treated in the washing and screening plant, where about 40 per cent of it is discarded as excess sand of which a pile containing 2,000,000 cubic yards has accumulated. Processed aggregate is carried from the washing plant to the main stock piles by a 48-inch conveyor belt, 5,965 feet long, at the rate of 35,000 tons or 700 carloads a day. In all, 4¼ miles of conveyors are handling gravel.

From the streams of sand, cement, gravel, and water poured into the two mixing plants, automatic scales, controlled by electricity and compressed air, weigh out in a few seconds precise portions of each component to make a 4-cubic-yard batch of concrete. With a 2-minute mixing period, the eight mixers in the two plants produce a uniform, high-strength concrete at the rate of a cubic yard in less than five seconds. A graphic record of the weight of each component and of the consistency of each batch is made automatically.

F. A. Banks is the Government construction engineer in charge of the operations.

# Barge Elevator with 118-Foot Lift

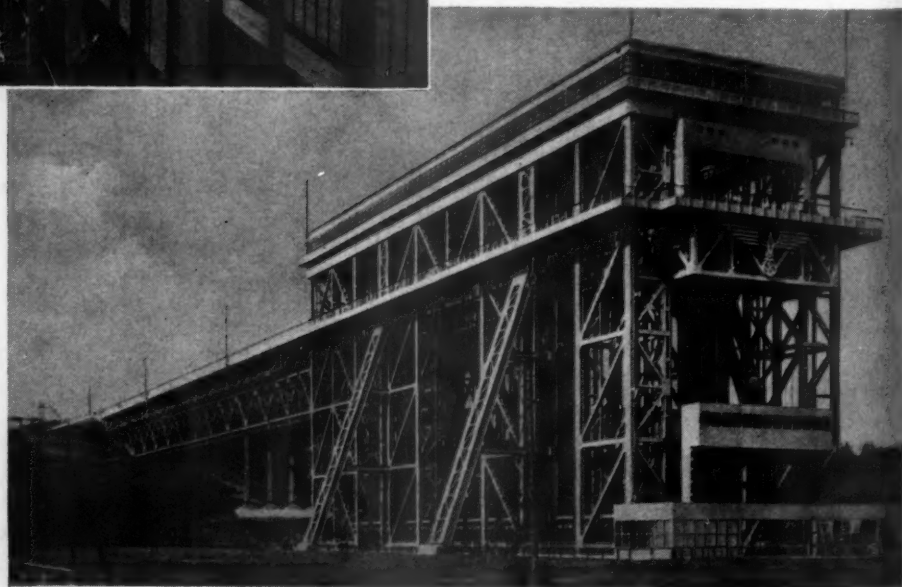
A. M. Hoffmann



## AT THE UPPER LEVEL

At the top is the Hohenzollern Canal end of the elevator with the gates open and a barge about to enter the trough under its own power. In the glass-enclosed section at the top of the structure, right, are the pulleys over which pass the 256 wire cables from which the trough and counterweights are suspended. The latter are in the form of heavily reinforced concrete slabs—192 in number—each 23 feet long, 1.6 feet thick, and weighing 22 tons.

**T**HREE and a half years of operation have proved the practicability of Germany's huge canal-boat elevator that rises incongruously like the steel framework of a skyscraper above a region given over to agriculture and dotted here and there with low-roofed farm buildings. It is a conspicuous feature of the countryside, and has come to be a point of unusual interest to the sight-seer. It is well worth a trip to watch barges being carried straight up and down a distance of approximately 118 feet between the Hohenzollern Canal—connecting Berlin with Hohensaaten—and the lower-lying waterway paralleling the west bank of the River Oder thence to Stettin. The latter canal was built because the Oder is subject to frequent floods and periods of



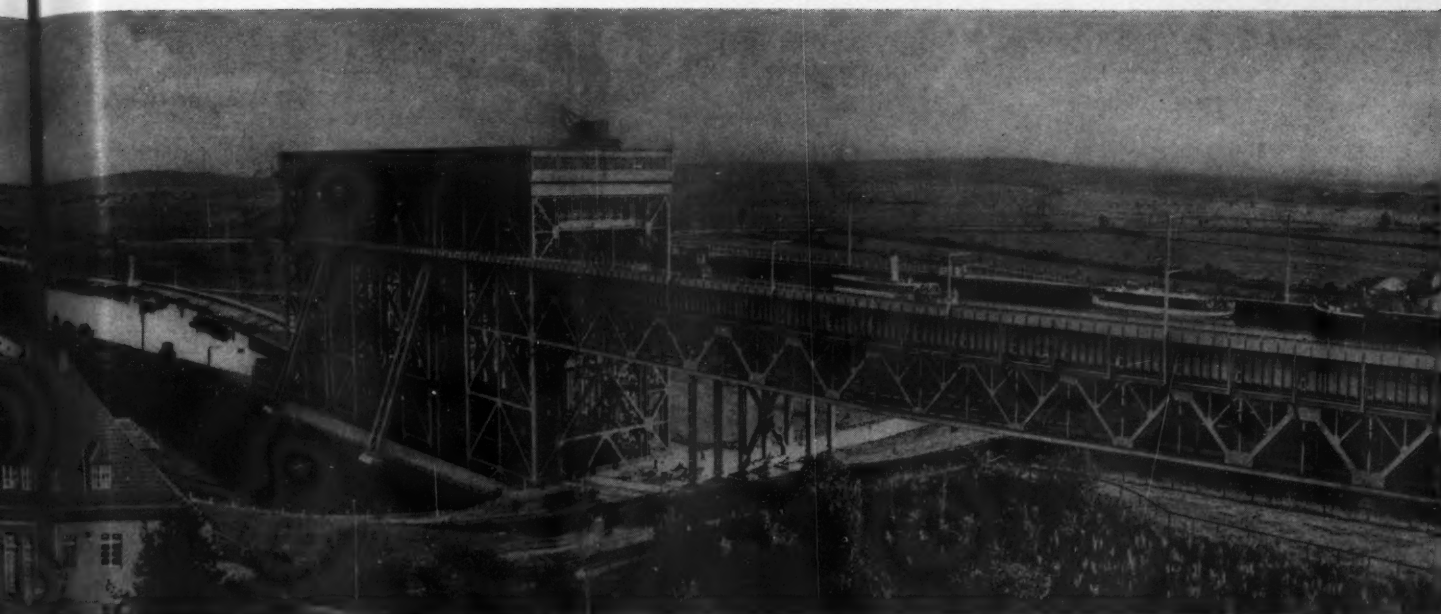
shallow water which seriously interfered with shipping and on occasions prevented navigation altogether. It was formed largely by linking numerous arms of the Oder flowing in the same general direction as the parent stream, from which the canal is entirely separated by dams.

Before the construction of the elevator at Niederfinow, close to the northern terminus of the Hohenzollern Canal, barges had to negotiate the rise or descent at that point

## THE GOLIATH AND ENVIRONS

From left to right are seen one of the four locks in the partly abandoned Finow Canal near its eastern junction with the Berlin-Stettin canal system, the barge elevator, and the bridge connecting it with the Hohenzollern Canal. To give the elevator a sufficiently firm footing, it had to be built somewhat removed from the uplift, and this accounts for the bridge, which is 512 feet long and has a lead trough to prevent leakage. Approximately 300 exploratory borings were made before the site for the structure was selected. On the upper level close to the elevator is one of the storage-battery locomotives that are used to tow barges in and out of the trough.

by means of four locks or steps of 29.5 feet each in the Finow Canal, a short waterway that for the most part will now be used only in case of emergency. It took approximately two hours for boats to make the passage through those locks. In the early days of the canal system that proved no hindrance; but when traffic gradually increased from 600,000 tons in 1923 to 2,340,000 tons in 1928 it often happened that vessels had to lie at anchor for days



awaiting their turn to go through. Since 1928, by reason of existing economic conditions, shipping has somewhat declined. By building the Hohenzollern Canal, the number of locks between Berlin and the Oder was reduced from 18 to 6, but any speed in traffic thus gained was offset by the locks at Niederfinow. That bottleneck had to be eliminated, and this was done by erecting the world's largest elevator for barges.

At this stage it might be of interest briefly to review the history of such structures, as the one under consideration is said to be the eleventh of its kind. The oldest was constructed in 1838 after plans developed in 1796. It is in England, on

the Grand Western Canal which connects the River Thames with the Severn. This lift consists of two wooden troughs 29.5 feet long and capable of accommodating boats having a carrying capacity of 8 tons. They travel up and down a distance of about 46 feet in two compartments separated by a wall on top of which are mounted three sheaves, one behind the other, over which pass heavy chains from which the troughs are suspended. The middle wheel is geared and engages another geared wheel that is turned by hand, thus raising one trough while lowering the other. Another and easier method of operating the elevator is to permit the upper trough to come to rest a little below its prescribed level.

Then, when the gate or bulkhead is opened, a stream of water pours in and destroys the equilibrium, causing that trough to sink under its own weight and to pull the lower one upward. This nearly 100-year old structure still stands and is giving good service.

At Anderton, England, is another hoist for canal boats. Erected in 1875, it also has two troughs, and in its original form operated on the hydraulic-lift principle. It was rebuilt in 1906, and is made up of a framework of steel within which the troughs go up and down as independent units. To each trough are affixed numerous wire cables which pass over motor-driven sheaves on top of the structure and carry counterweights at the opposite ends. The difference between the two levels is 49.5 feet, and each trough is large enough to hold a barge of 100 tons capacity.

Of the remaining nine elevators all but two are of the hydraulic-lift type. Although differing in construction, the basic principle on which they operate is the same, and



#### READY FOR THE ASCENT

The trough at the lower level with a barge and its tug in position. Immediately above them, in the foreground, is one of the two engine rooms that span the trough. In the location map, right, the heavy black line indicates the Berlin-Stettin barge canal, which is one of the principal ones in Germany's extensive system of waterways. The short dotted line shows a part of the old Finow Canal. This, together with its four locks at Niederfinow, is being maintained so as to serve in case of breakdown of the elevator.



it will therefore suffice to give a broad description thereof. The design always calls for twin troughs spaced close together in a supporting framework and each resting midway of its length on the piston of a large steel cylinder standing upright in a shaft carried well below the water line.

An accompanying sketch of the arrangement, in its simplest form, shows that the two hydraulic hoists are connected near the top by a pipe in the center of which is interposed a valve for the control of the water. The system is such that when one trough sinks the other automatically rises. To accomplish this it is necessary first to anchor the troughs at their landings so that the upper one is slightly below and the bottom one slightly above the normal water level. Then the valve between the cylinders is closed and the gates at the entrances to the troughs are opened, permitting a small stream of water to pour into the upper one and a corresponding stream to flow out of the lower one. With the balance thus destroyed, and with the boats floated in position, the gates closed, and the valve opened, the upper trough, being the heavier, will sink. In doing so, the piston on which it is mounted is forced down, displacing the water in the cylinder and causing it to flow through the pipe into the companion cylinder, where it pushes the piston of the temporarily lighter trough upward. Of the seven structures of this kind in existence one is in France, two in

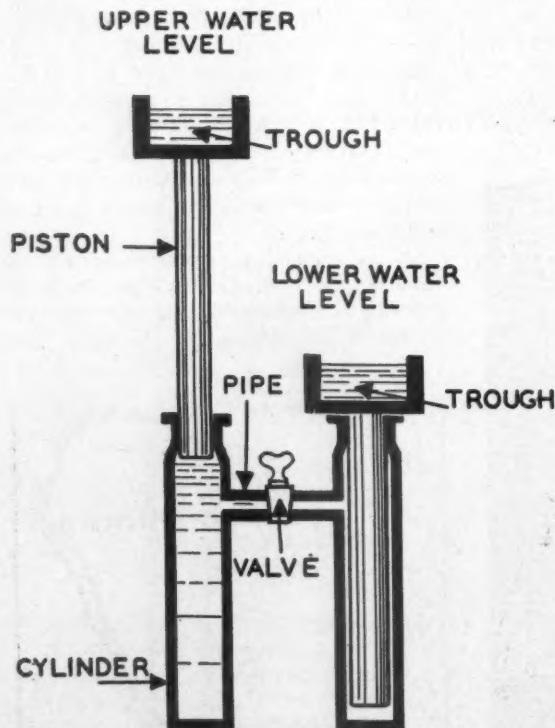
Canada, and four in Belgium, the oldest one dating from 1888. It should be remembered, however, that the 1875 Anderton elevator, previously mentioned, was originally of this type.

And now we come to the largest of the forerunners of the Niederfinow lift. It is in Germany, at Henrichenburg, and serves shipping on the Dortmund-Ems Canal. It represents still another though more complicated system. In this case there is but one trough which is supported throughout its length by five 59-foot-high structural-steel piers resting on a like number of vertically disposed hollow steel cylinders each of which floats in a well 98 feet deep. These wells are connected at the bottom by piping by means of which the water in all of them is kept at a constant level. Together, the cylinders exert sufficient buoyancy to raise their load, and this is accomplished without destroying its equilibrium. When filled with water, the trough weighs about 3,000 tons, and the distance between levels is 47.5 feet. Motive power is required to lower the trough together with its floats, and this is effected through the medium of elevator screws, which likewise make it possible to do both the lowering and the lifting at a uniform rate of speed and without jamming and tipping.

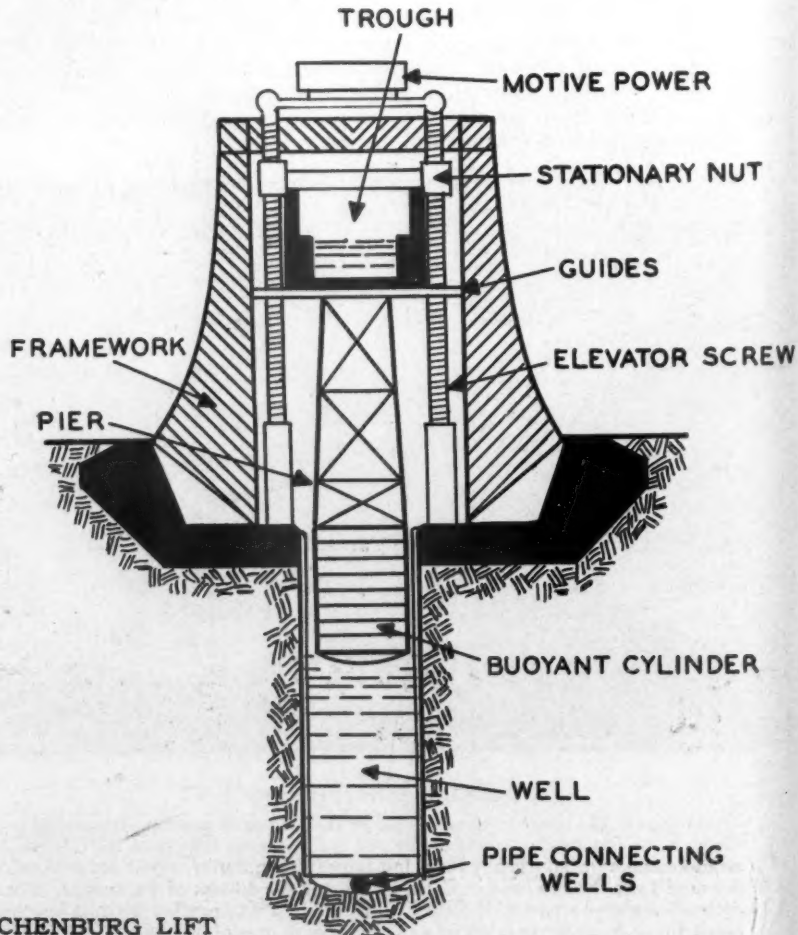
In point of size, all these structures are dwarfed by the giant elevator linking the Hohenzollern Canal and the waterway alongside the Oder. Its steel framework is

197 feet high, 88.5 feet wide, and 308 feet long, and is set in a concrete basin 26.25 feet deep, 110 feet wide, and 367.5 feet long, resting on nine piers which reach a maximum depth of 65.5 feet. The largest of these has a footing covering an area of 3,229 square feet. These piers extend below the ground-water level and were sunk by the pneumatic-caisson method. The trough measures 288.5x52.5 feet overall and can accommodate four so-called Finow barges each of 250 tons capacity, or one 600-ton barge and tugboat, or one 1,000 ton barge. Empty, it weighs 1,700 tons; but in service, when filled with water to a depth of 8.2 feet, it has a total weight of 4,300 tons. This remains constant whether the trough is loaded or unloaded because the weight of the water displaced by a vessel upon entering is equivalent to the deadweight of the craft.

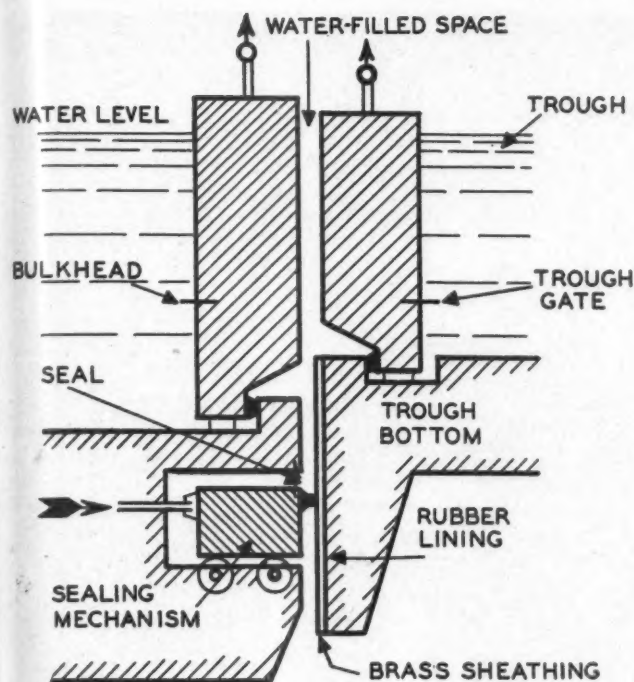
It is interesting to note that of the many designs which were offered in competition, the one finally accepted operates on the same principle as the original types—that is, it makes use of counterweights. It has 192 of them, fastened to the ends of 256 wire-rope cables—128 on each side—from which the trough is suspended. They are made of heavily reinforced concrete, weigh 22 tons apiece, and are attached in groups of six to a scalebeam hanging from eight cables. The arrangement is such that should one of the six middle cables of such a group break, the particular counterweight would still be held,



SIMPLE FORM OF HYDRAULIC LIFT

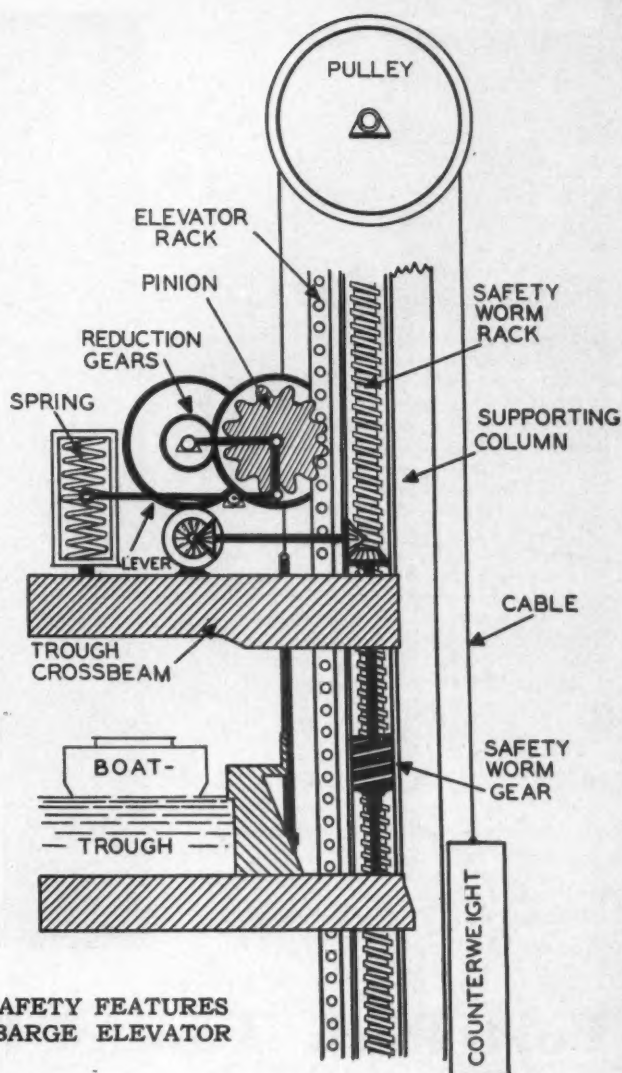


CROSS SECTION OF HENRICHENBURG LIFT



#### SEALING MECHANISM

This cross-sectional drawing shows how the space between the trough gate and the canal bulkhead of the Niederfinow elevator is sealed to prevent the water from flowing down and out when barges are being floated in or out of the trough. After the gates are closed the space is unwatered.



#### OPERATING MECHANISM AND SAFETY FEATURES OF THE WORLD'S LARGEST BARGE ELEVATOR

and the load would be taken up equally by the two outer cables.

Each cable consists of six 37-wire strands, or a total of 222 wires, which are laid around a hemp core, and has a breaking strength of 150 tons, thus giving it a margin of safety of 128 tons. The cables run over 128 double pulleys in the top of the elevator housing—one right-lay and one left-lay cable in the case of each pulley; and so that the trough and counterweights may always be in equilibrium, the total weight of the cables, which is 90 tons, is compensated for by four chains of 22.5 tons each. These extend from the underside of the trough frame to the bottoms of four equidistant counterweights, passing under rollers at the base of the structure.

Power to set the trough in motion is provided by four electric motors of 75 hp. each, and is transmitted through reduction gearing to four sturdy pinions which engage vertical racks attached to the steel framework of the elevator. Up and down these the trough climbs at the rate of 23.6 feet per minute, covering the ascent or descent of 118 feet in five minutes—the cables and counterweights automatically traveling along the while. The arrangement of the driving mechanism is such that should one motor fail the others will take

over its load, and that in case of any unforeseen variation in weight, which would destroy the balance, the trough will be brought to an immediate stop regardless of its position.

The entire operation of loading, hoisting or lowering, and unloading the trough takes about twenty minutes, or just one-sixth the time formerly required to run a barge through the locks. The boats, whenever possible, enter and leave the trough under their own power, otherwise they are towed by means of storage-battery locomotives, one on each level. Only three persons are needed to run the elevator: one engineer and one trough attendant and helper. There is one driver for each of the two locomotives, making five men all together.

It is fascinating to watch the giant lift at work; and in the summer the number of visitors averages as many as 50,000 a month. With a barge or barges anchored in the trough, the entrance gate and adjacent bulkhead are lowered—the space between the two being sealed the while to prevent the water from leaking down and out. When both gates are seated, the space is unwatered. Not until all these preliminaries are finished can the motors be started, the lift soon attaining its maximum speed. When it gets close to the landing it slows

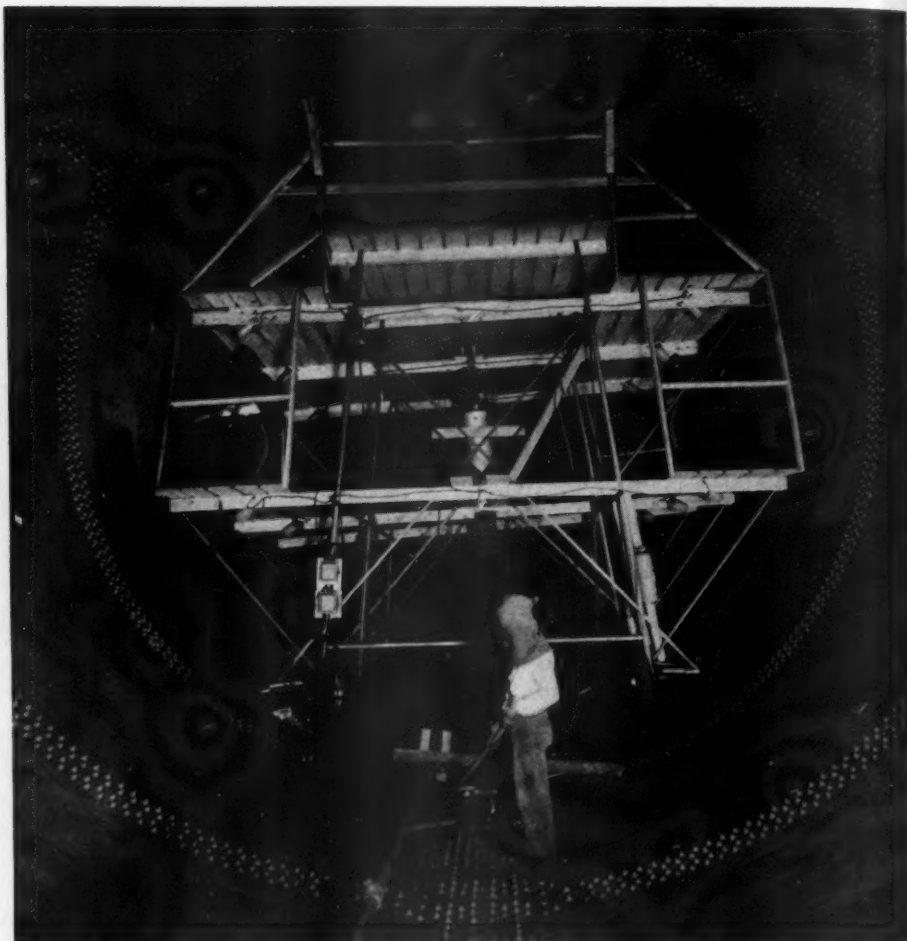
down, gently coming to rest at the right point. There the operations just described are reversed, and another craft, already waiting, is floated in to make the rise or descent, as the case may be. Everything moves with precision, the men in attendance performing their several duties in proper sequence and without the noisy shouting of orders.

Since the Niederfinow elevator was put in service on March 21, 1934, it has handled as many as 124 barges in a 16-hour working day. That was a record, however. The first year it transferred 23,610 vessels, or an average of 64 barges a day, a figure that has dropped in the meantime to around 55. Under existing operating conditions, the lift has a carrying capacity of 10,000,000 tons annually, or 5,000,000 tons of freight. This is considerably in excess of the country's present transportation needs.

It took eight years to complete the structure, which involved the excavating of 1,960,000 cubic yards of material and the use of 94,000 cubic yards of concrete, 2,000 tons of reinforcing steel and iron, and 10,500 tons of steel. It was designed by the Reich Waterway Authorities and built at a cost of 27,700,000 Marks, which, at the present rate of exchange, represents an expenditure of \$11,124,320.

#### HOODED BLASTING CREW

This picture shows the rubber-tired gantry that led the procession of similar working platforms used in cleaning and painting the steel-lined section of No. 1 Diversion Tunnel that may serve as a penstock for a projected hydro-electric plant at Fort Peck Dam. The four men on the carriage are preparing the metal surface for the primer coat by removing all scale, rust, and other foreign matter with sharp abrasives applied with compressed air at 80 pounds pressure. In the center of the lower platform is the small receiver that supplied air to the helmets worn by the operators to protect them from flying particles and dust. The worker in the foreground is sweeping up the grit for re-use.



## Fort Peck Tunnel Partly Lined with Steel

A. H. Martin

**A**NOTHER milestone was reached in the building of the Fort Peck Dam on June 24, when the course of the Missouri River at that point was changed by conducting its waters through the four large diversion tunnels on which work had been begun just three years earlier. On that day the earth dike, the only barrier that prevented the stream from flowing into the tunnel intakes, was blasted away, and construction crews started dumping coarse gravel and glacial boulders across the channel to check the river's flow. From a railroad bridge paralleling the dam site, 15,000 to 20,000 cubic yards of material was placed on the first day along the downstream edge of the 100,000,000-cubic-yard hydraulic-fill barrier which the U. S. Army Engineers are rearing across a 9,000-foot-wide valley to form a reservoir that will extend upstream for nearly 180 miles and impound 19,412,000 acre-feet of water.

The diversion tunnels have an average length of 6,323 feet and are lined with concrete, with the exception of about half of No. 1 which has been given an added lining of steel so that it can be used later on as a penstock should that tunnel become a part

of a contemplated hydro-electric plant. The steel tube extends from the outlet portal to the control-gate shaft, a distance of 3,113 feet, and has an inside diameter of 24 feet 8 inches and a thickness ranging from 1 inch at the shaft to 1¼ inches at the outlet end. It is made up of 25-foot sections of nine plates each riveted together longitudinally with ½-inch rivets and the use of inside and outside splice plates and transversely with 1-inch rivets and outside splice plates. Every 2 feet 9 inches the tube is banded with 6-inch H-beam stiffeners welded to it at intermittent points along the edges of the inside flanges.

The sections were assembled in a field plant at the dam site, and all the rivets driven were subjected to the standard hammer test for tightness, as well as to a special air test to determine leakage. This consisted of placing a pressure hood over from eight to twelve rivet heads on the inside of the lining and applying a soap solution to the associate rivet heads and seams on the outside, all leaks being indicated by the formation of bubbles as soon as compressed air was admitted to the hood. By adding glycerine to the solution

it was possible to do this even when the temperature was as low as 20° below zero Fahrenheit.

With the riveting, welding, and testing completed, the 36-spoke spiders which had been fitted in each tube section to prevent distortion during assembly were replaced by 18-spoke spiders. These served to keep the units in shape during storage, transportation, and concreting. The contract for fabricating the steel plates, assembling them at the dam site, and delivering the finished sections at No. 1 Tunnel was awarded to the Chicago Bridge & Iron Company.

The installation of the penstock was carried out by the Government with its own equipment and working force. Each 25-foot unit weighed around 67 tons and was transported and maneuvered into position by means of a special carriage. This was mounted on four large wheels running on an 8½-foot-gauge track and hauled by a storage-battery locomotive traveling on a 3-foot-gauge track located between the former and on a grade 4½ inches lower in order to provide ample clearance beneath the tube. Two of these carriages were in

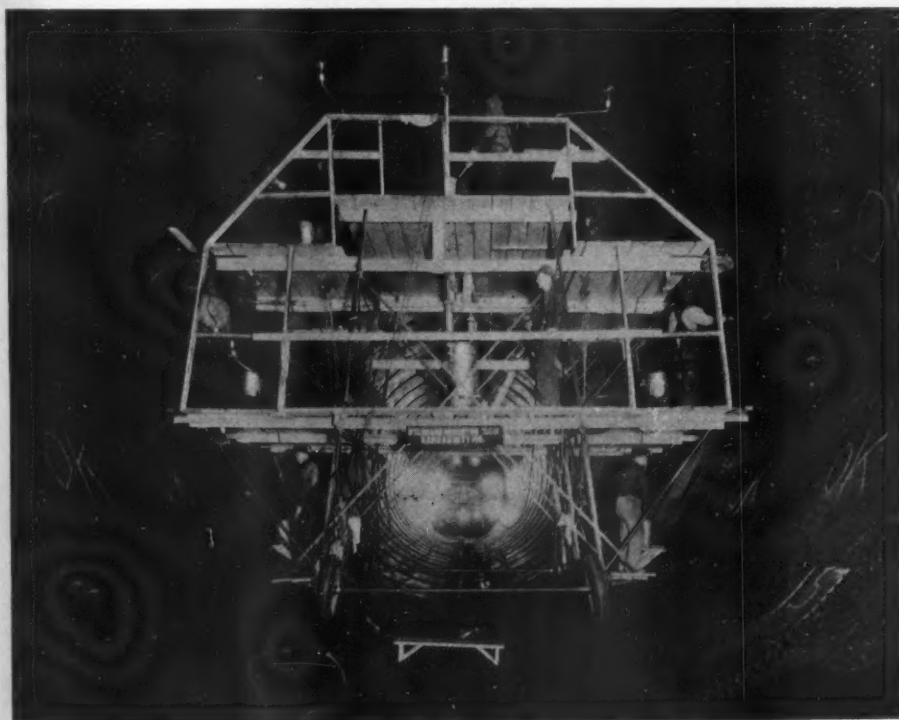
use, one at each end, and were arranged so that they could turn, lower or raise, and shift the incoming sections to the right or to the left—being withdrawn, together with their tracks, as soon as the joints had been pinned and bolted and steel pedestals shimmed and wedged tight under the steel lining. Some difficulty was experienced, however, in subsequently aligning the sections, but this was partly overcome by accurately measuring each before putting it in place and by tack-welding shims of varying thicknesses not exceeding  $\frac{1}{4}$  inch at suitable points around the transverse joint. Successive lengths were riveted together from inside the penstock with air-operated riveting hammers; and to prevent the air in the tunnels from becoming contaminated with gas, oil, or coke fumes, the rivets were heated by electricity and delivered through a flexible metal hose with air under pressure to the buckers-up behind the tube.

Concreting of the annular space between the lining and the tunnel wall was done in 75-foot sections by two pneumatic guns each with a capacity of  $\frac{3}{4}$  cubic yard. These were mounted on a jumbo that was carried in and out of the tunnel as required on one of the carriages used to haul the penstock units. By means of two 6-inch pipes, each 80 feet long, concrete was "shot" to any point within the prescribed limits from three working positions: the first, 6 feet above the concrete invert; the second, right



#### INSPECTING THE TOP COAT

Every square foot of the 242,000 covered with coal-tar enamel had to be tested, and this picture shows how it was done by a Government inspector. The detector or "broom" used had wire bristles, and these were charged with electricity, the other half of the circuit being grounded to the steel lining. Whenever there was a flaw in the coating, a spark jumped from the bristles to the plate as they passed over it, and no section of the tube was marked "O.K." until it had been swept by the broom without drawing a single spark.



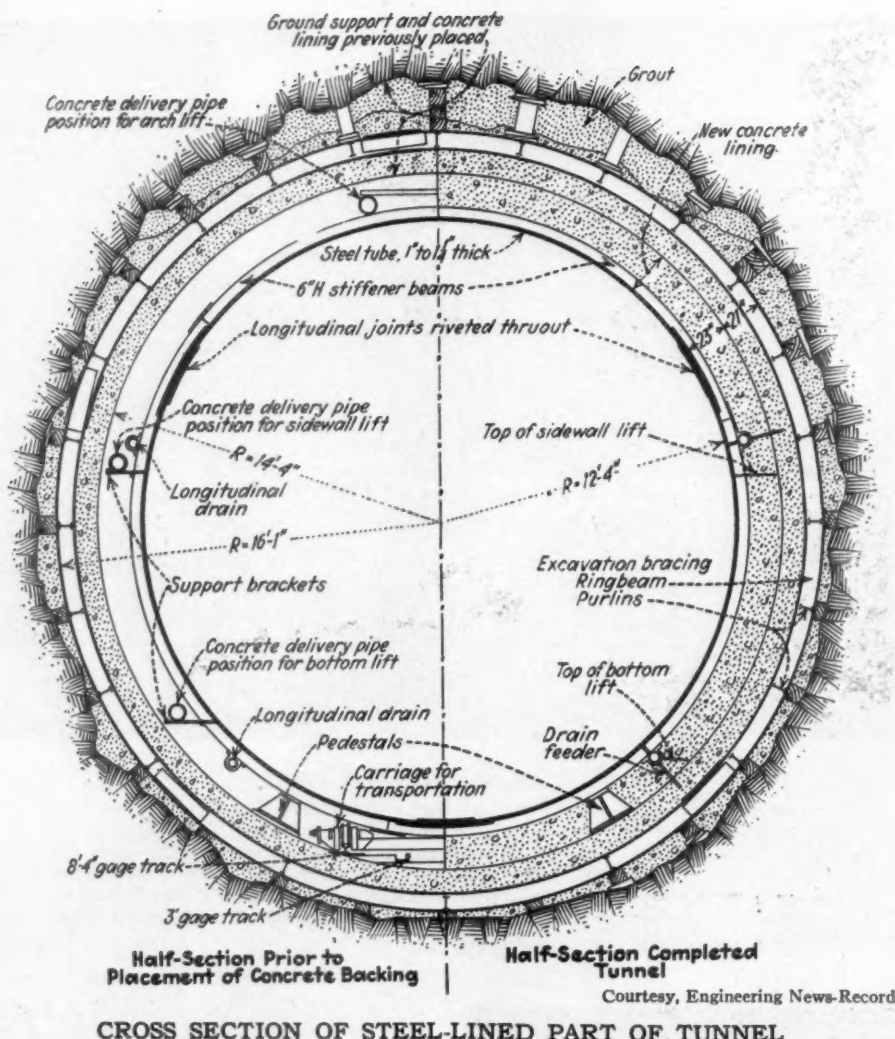
#### APPLYING THE "HOT STUFF"

After the primer coat had dried, the painters came along and applied the coal-tar enamel with Tampico dauber brushes. Each worker, as the picture shows, had an electrically heated paint pot which was provided with thermostatic control to keep the bituminous material at the required temperature. Two portable kettles of special design were kept busy 24 hours a day supplying enamel to twenty "daubers," ten on each of the two gantries used to do this work. Compressed air and blower fans served to clear the air in the vicinity of the painting operations of fumes.

above the spring line; and the last just off the crown. Concrete was delivered by train from a mixing plant at the outlet portal in 2-cubic-yard buckets. These were lifted from the cars and dumped into the hoppers of the pneumatic guns—one on each side of the center line of the tunnel—by an electric trolley hoist on top of the jumbo.

According to Capt. A. W. Pence, Corps of Engineers, U. S. Army, at Fort Peck, "A complete cycle of operations for a 75-foot advance, including movement underground of three steel tube sections, fit-up, driving 3,150 rivets, placement of concrete machinery, pouring 433 cubic yards of concrete, and removal of concrete machinery, was finally worked down to a period of  $2\frac{1}{2}$  days. The whole placement job was completed in four months and seventeen days." Following concreting, holes were drilled through the steel lining into the invert and the arch and filled to refusal with grout applied with compressed air at a pressure of 30 pounds per square inch.

On the outside of the penstock there are four longitudinal drain pipes, each  $5\frac{1}{4}$  inches in diameter, with feeder holes on 25-foot centers passing through the tube and the drains and extending 6 inches beyond the point where the original tunnel lining and the new concrete come together. These feeders will serve to relieve any water pressure that might build up between the steel and the concrete. Each hole in the tube was



CROSS SECTION OF STEEL-LINED PART OF TUNNEL

subsequently sealed with a standard pipe plug; and at the downstream end the pipes connect with a circumferential drain and an outlet leading to a sump.

Next came the work of cleaning and painting the steel lining. First it was swept, sharp edges were ground smooth, and a solvent was applied to remove grease and oil. With these preliminaries completed, the actual finishing operations were begun. These involved grit-blasting the entire 242,000 square feet of surface and covering it with a primer coat of coal-tar paint and a top coat of coal-tar enamel. The contract for both jobs was let to the Standard Asbestos Manufacturing & Insulating Company, Kansas City, Mo., and amounted to \$35,985.40, not including the cost of the bituminous materials which were supplied by The Barrett Company of New York, N. Y.

Hard, crushed steel, much like coarse sand in appearance, was used to do the blasting and was applied with compressed air at 80 pounds pressure. Four men were assigned to do this work, and they directed the jets of abrasives against the rusty steel lining from a 2-platform gantry on rubber wheels. The grit was stored in two containers, with a combined capacity of 5,000 pounds, and these were mounted on a special carriage that followed behind the gan-

try, to which the abrasive material was fed through connecting air lines. The operators wore dustproof helmets and drew compressed air for breathing from a small receiver and manifold on the gantry.

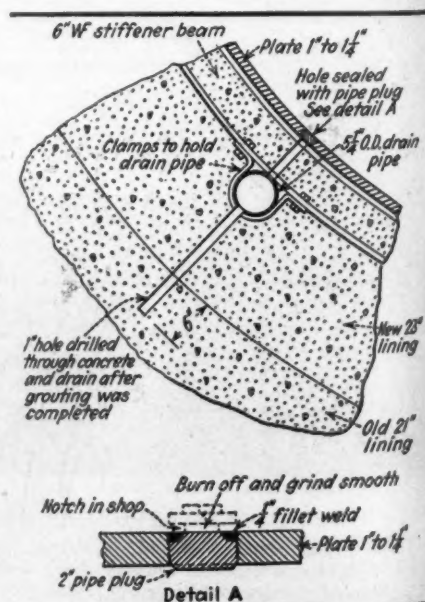
Back of the blasting equipment came the painters, on a movable platform, who gave the clean surface the primer coat. This was put on cold by means of spray guns, and within 24 hours, the drying period specified for the coal-tar paint, followed the men with the coal-tar enamel. They also worked from rubber-tired platform gantries, but had to use dauber brushes because the hot material could best be spread in that way. Until the enamel was brought in contact with the steel it had to be kept hot and at a constant temperature. This was done by the use of electrically heated paint pots and two portable kettles. The latter were made especially for the Standard Asbestos Manufacturing & Insulating Company and consisted of a vat over an insulated case between which were suspended eighteen 80-kw. electrical heating elements. In each of these within a period of four hours 300 gallons of the bituminous mixture was brought to a temperature of 450°F., at which it was maintained by two thermostats, one in the vat and the other in the heating chamber. When the contents had

been raised nearly to the desired point, one of the several switches with which each kettle was provided reduced the wattage to about one-third of the rated capacity, and this was sufficient to keep the enamel at a uniform temperature until it was all drawn off.

Proceeding from the outlet portal to the shaft, all but the invert was given a top coat 1/16 inch thick. That part of the steel lining was painted on the return trip, when the equipment that had been required for the various finishing operations was backed out of the tunnel. All the work was closely supervised by U. S. Army Engineers; and as each section of the 3,113-foot tube was enameled, a Government inspector tested every square foot of the surface with an electric flaw detector or "broom." This device had wire bristles which were charged with electricity, the other half of the circuit being grounded to the steel lining. Any spot not properly covered was revealed by sparks jumping from the bristles to the plate, and had to be gone over before that plate was marked "O.K."

The necessary air for all these operations was supplied by Ingersoll-Rand machines in a compressor plant near the outlet portals of the diversion tunnels, and was delivered to the points of use by a 2-inch pipe. Valves at frequent intervals in this line offered ready means of connection as sand-blasting and painting advanced.

At one o'clock on the afternoon of June 24, last, the penstock was completed, about two months after work on it had been started, and a little more than three hours later water was flowing through it and the three other tunnels, thus changing the course of the Missouri at the site of Fort Peck Dam for the purpose of filling in that section of the structure which is to stand squarely athwart the river.



DETAILS OF DRAIN FEEDERS

## Opening a New Coal Mine



### DRILLING IN ROUGH COUNTRY

West Virginia terrain is nearly all very rugged and in places it is precipitous. Accordingly drilling calls for equipment that can be readily moved over rough ground and that at the same time is powerful enough to put down the deep holes that are required effectually to blast side-hill sections. The answer is

found in the wagon drill. The two small pictures show Ingersoll-Rand drifter drills on Type FM mountings supported on staging that can be quickly set up. In the large view is a drill on a Type D mounting that is held upright by guy ropes. Note that one of its wheels is several feet off the ground.

*William S. Powell*

THE Virginian Railway Company is building a branch line approximately 20 miles long from Simon, on the Guyandot River, up Clear Fork Creek, in Wyoming County, West Virginia. The line is being constructed to serve a new coal mine being opened up by The Koppers Coal Company, of Pittsburgh, Pa., on the upper waters of Toney Fork.

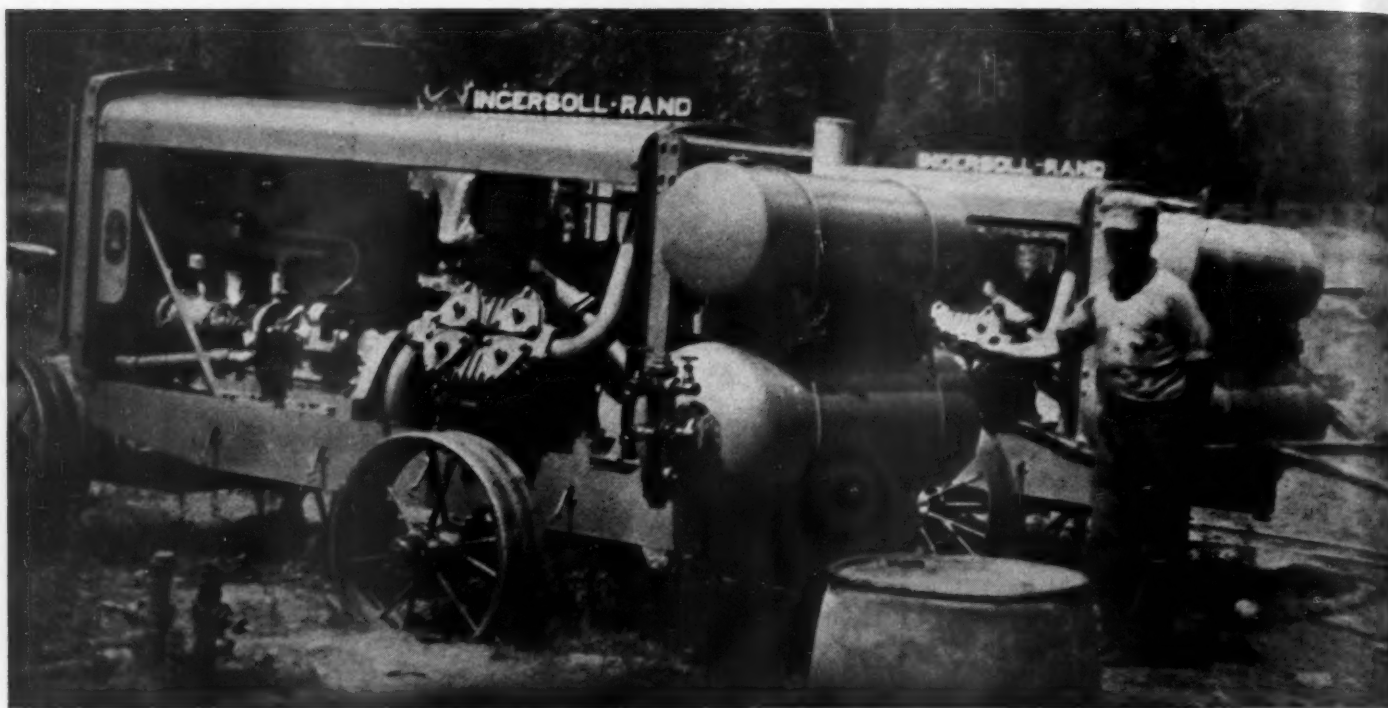
The work is in charge of two well-known southern contracting firms: W. W. Boxley, Son & Company, railroad contractors of Roanoke, Va., are building 13 miles at the southern end, and Sutton Company, Inc., general contractors of Ashland, Ky., are constructing the remaining 7 miles. Both

concerns are making good progress and expect to be finished about January 1, unless they are delayed by unusually severe winter-weather conditions. Modern rock-drilling equipment and dirt-handling machinery are being used by both contractors. The line traverses typical West Virginia mountain land, which calls for alternate cut and fill work.

The Boxley contract involves about 300,000 cubic yards of excavating and the placing of 8,000 cubic yards of concrete. Approximately 70 cast-iron culverts, ranging in diameter from 18 to 36 inches, will be laid. The masonry work required in connection with them will be done by the

Smith Leach Company of Roanoke, Va. Operations were started on April 5 of this year, and are being directed by Abney Boxley, with J. G. Johns as superintendent.

Heavy drilling is being done with drifter drills of the Ingersoll-Rand X-71, DA-35, and N-75 types on wagon mountings, there being five outfits of this kind on the job. Nine S-49 and S-68 Jackhammers are being used for block-holing and shallow-hole work. Compressed air is furnished by seven Ingersoll-Rand portable compressors of which three are 10x8-inch water-cooled units, three are Model 315 air-cooled machines, and one is a Model 210 air-cooled type. For loading and hauling blasted ma-



#### SOURCES OF AIR SUPPLY

Portable compressors are particularly suitable for work of this nature, and the two contractors on this job are using fifteen Ingersoll-Rand units. Seven of them are air-cooled models, similar to the two illustrated here.

material there are in service a Koehring and a Marion shovel, both of  $1\frac{1}{2}$  cubic yards capacity, and seven 4-cubic-yard Koehring "dumpsters."

The Sutton Company is using similar drilling equipment on its contract. All its five wagon drills are X-71 drifters on Type D mountings, and six JA-55 Jackhammers are doing supplementary drilling. Compressed air is supplied by eight I-R portable compressors. Three are Model 315 air-cooled units: the others are water cooled and consist of three 10x8-inch machines, one 9x8-inch, and a Type XL with horizontal cylinders. All drilling is being done with "Jack-bits." Loading and hauling equipment consists of two "77" Lorain  $1\frac{1}{2}$ -cubic-yard shovels, one Lorain  $\frac{1}{2}$ -cubic-yard shovel, two RD-8 Caterpillar tractors, two 75 Caterpillar tractors, two 60 Caterpillar tractors, one RD-8 bulldozer, one Allis-Chalmers bulldozer, two Euclid Trac-Truks, and a number of LaPlant-Choate and Athey dump wagons. W. D. Sutton is directing the work for his company, with Taylor Boxley and Ballard Lowe serving as superintendents. Operations were started on July 1.

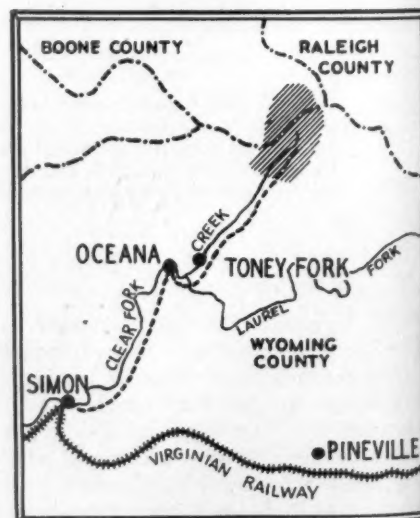
The Virginian Railway, of which the new line is a part, runs from Norfolk, Va., westward to Deepwater, W. Va. It taps the New River-Pocahontas coal field, and its 619 miles of road carries a heavy traffic in coal. The new mine will very likely start producing next spring. The property consists of 10,000 acres of land leased from the Loup Creek Company Collieries of Page, W. Va. The Eagle seam, one of the lower beds, will be opened up first, and the Campbell Creek seam, lying immediately above,

will be worked later. Both contain good-grade by-product coals. Preliminary engineering and prospecting was begun last February for the purpose of determining the geological conditions that will be met underground. Four corps of engineers and an office force, in charge of H. John Harper, resident engineer of The Koppers Coal Company, are examining outcrops and conducting diamond-drill tests.

What will be one of the most modern coal-mining towns in the country is to be established at the mine site, and some 200,000 cubic yards of excavating will be required in creating it. Approximately 350 houses will be built for the miners and their families along the single main street and the various cross streets that have been projected. These houses will be of different sizes and designs and will contain three, four, five, and six rooms. The town will also have a community center, schools, recreation buildings, clubhouses, a church, swimming pool, doctor's office, and a store. Mining facilities will include a machine shop, car-repair shop, oil house, supply house, platforms for the storing of rails and steel ties, and storehouses for cement and materials. The town will be ready for occupancy by the time mining operations are begun. Construction costs have not yet been estimated.

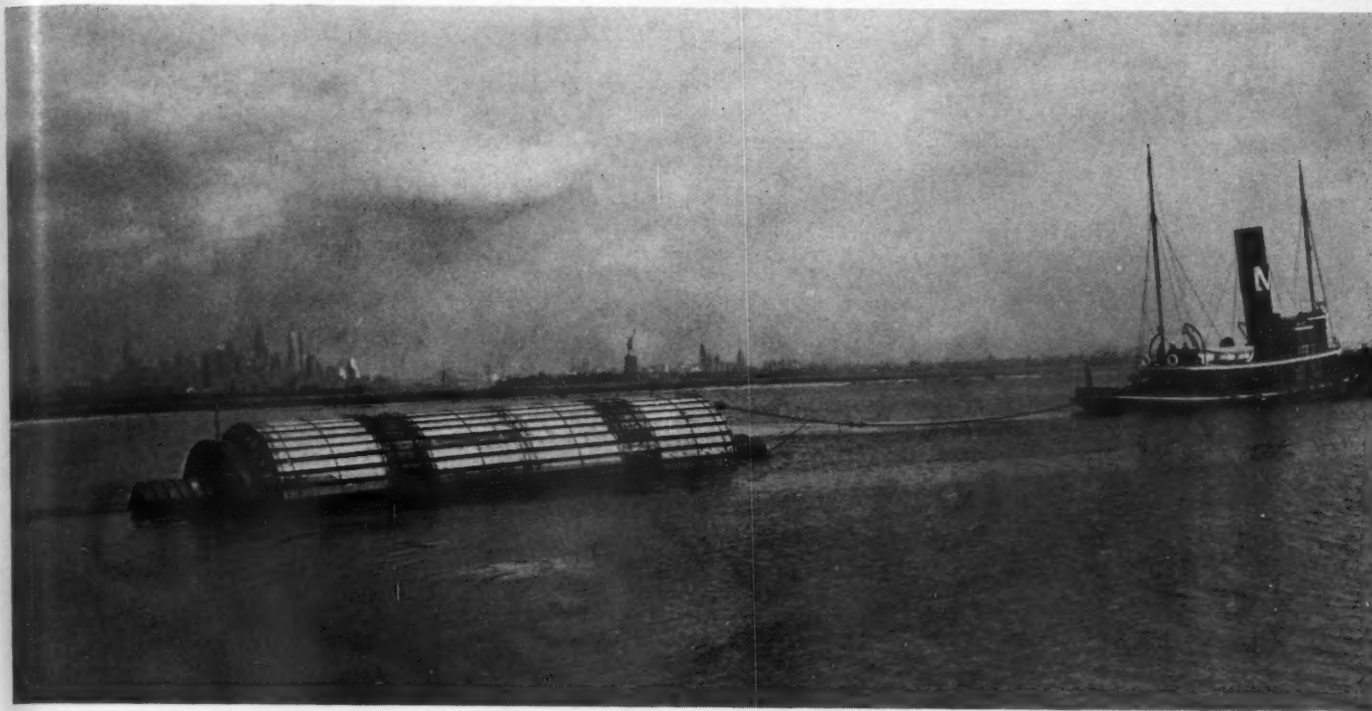
A central water plant will be built, together with adequate facilities for the treatment of the water. A sewerage system also will be established and maintained. Electricity for lighting the streets and houses will be obtained by tapping a high-tension line that is being extended to the colliery site.

The mine tipple will be designed to handle approximately 4,000 tons of coal a day. It will be of the 4-track type, with provision for the installation later of a coal washer. The coal will be delivered from the headhouse to the tipple by means of a belt conveyor spanning a small valley at an elevation higher than that of the tipple. It has been impossible to predict the ultimate production of the mine because that will depend upon market conditions.



#### LOCATION MAP

The dotted line shows the route of the railroad branch, and the shaded area indicates the location of the new coal field which it will serve and which is being developed by The Koppers Coal Company. The road will have a length of approximately 20 miles.



#### STARTING ON A LONG TRIP

A 230-ton oil-refinery evaporator tower starting its voyage from Jersey City, N. J., to Whiting, Ind. To protect it against damage from possible impacts, the 80-foot-long cylinder was

sheathed with 14-inch square timbers running longitudinally, and all manholes and other projections were covered with additional timbers.

## Huge Tower Towed 1,371 Miles

**A**N EVAPORATOR tower of 230 tons for oil-refinery service was recently transported 1,371 miles from Jersey City, N. J., to Whiting, Ind., by the unique method of towing. The tower is 80 feet long and 15 feet in diameter, and is believed to be the largest piece of industrial freight ever moved such a distance. Towing had to be resorted to for the reason that the great size of the tower precluded the use of any of the conventional means of shipment. If sent by rail, it would have juttied out so far on the sides as to strike trains on adjoining tracks. Transportation by boat also was impossible as no steamer or barge operating through the New York State Barge Canal could possibly have passed under some of the fixed bridge spans had the tower been placed on deck, and its size and weight prevented stowing it in the hold.

The tower was manufactured by The M. W. Kellogg Company for the Standard Oil Company of Indiana. It weighs more than the Statue of Liberty and twice as much as what the *Mayflower* weighed in which the Pilgrim Fathers crossed the Atlantic. It is 25 feet longer than the longest flat car in the country, and its diameter is approximately that of one of the subway tubes under the rivers of New York City. It was fabricated from steel plates 50 feet long, 10 feet wide, and 2 5/16 inches thick—the longest of the kind ever made. The joining of these required the welding of

more than 600 feet of seams. These, to check the effectiveness of the welding, were X-rayed throughout their entire length, necessitating the taking of more than 1,000 pictures.

At the time work was begun on the tower it was known that special plans would have to be made for shipping it, and Kellogg engineers and the personnel of the traffic department set about determining the most suitable method and making detailed preparations for its delivery. A check of the weight, dimensions, buoyancy, and other characteristics of the tower proved that it would be practicable to ballast and partly to submerge it in water—in other words, to tow it. The available water route via the Hudson River, New York State Barge Canal, and lakes Ontario, Erie, Huron, and Michigan then had to be surveyed, with special attention to the depth of water in the Barge Canal stretch and to the clearances under the bridges and other structures that span it.

Once these investigations had disclosed the feasibility of making the long tow, a seemingly endless number of small but nevertheless vitally important details had to be worked out. These included the building of special railroad tracks inside the Jersey City plant and the cutting of larger doors through some of its walls to permit getting the tower out; bringing to the plant two of the only ten flat cars in

the country capable of sustaining the weight of the tower during its transfer from the plant to the wharf; securing the world's largest floating derrick with a lifting capacity of 250 tons to shift the tower into the water; chartering a tug for the long trip and arranging for additional tugs for certain parts of the journey; strengthening the wharf at Whiting to carry the load of the tower; and designing special hoisting equipment and a new arrangement of pulleys and cables to get the tower out of the water at the end of the voyage and to load it on to flat cars for transferring it to the refinery. All these plans had to be coordinated so that everything would work with clock-like precision.

When it was launched in New York Bay, the tower was floated with the manholes downward, and it was carefully ballasted to prevent its rolling over during the passage through the Great Lakes. Then it was filled with compressed air at 25 pounds pressure to give it the desired buoyancy. It was ballasted so that it would float approximately two-thirds submerged. Actually, 10½ feet of its 15-foot girth was underwater. This gave a clearance of only about 6 inches between the bottom of the tower and the bed of the shallowest sections of the canal. During the lifting and launching operations, more than 200 tons of water ballast was pumped into and out of the floating derrick.



## MACHINES AND MEN

**A**LTHOUGH there may be no clear-cut agreement as to what caused the cataclysmic business depression that began in 1930, there can be little doubt that complete emergence from it must await a better adjustment between the labor supply and the number of available jobs. And, without being pessimistic, we must admit that, in view of the widespread and growing mechanization of industrial processes, a satisfactory adjustment cannot be expected immediately.

The machine age is one of anomalies. It helps even those that it hurts. By and large, the ascendancy of machinery has made the lot of the human race an easier one, and even those that have temporarily become its victims would not willingly return to the old order of things. For example, a man who has lost a job because a machine can now perform his work would not want to have abolished all the mechanical advancement that has made life more comfortable for him. He would hardly care to trade his automobile for a horse and buggy, even though the car may be somewhat the worse for wear. Nor would he want to see his wife again submitted to the drudgery of the days before vacuum cleaners, mechanical washing machines, and other labor-saving household devices came into general use.

Out of all the welter of facts and theories and arguments relative to what should be done or what can be done to create more jobs, the truth remains that machinery does many things better and less expensively than men can do them. Under the circumstances, to abolish such machinery would be to take a step backward, and that is contrary to the way of the world.

In a recent address to the National Machine Tool Builders Association, A. C. Danekind, chairman of General Electric Company's committee on factory equipment and practice, made clear the current trend in industry and traced its development. Until a few years ago, he pointed

out, highly skilled craftsmen of the thorough, leisurely type, produced most of the accurate machine work in industrial plants. The revolution started when Henry Ford discarded the Model T car and announced that in its successor, the Model A, all machined parts would be produced to tolerances much closer than they had ever been maintained. To do this without making the car inordinately expensive, he pressed the machine-tool makers for equipment that was far more accurate and dependable than any previously available. Moreover, he insisted that such equipment be easy to operate. This movement, according to Mr. Danekind, transferred the responsibility for maintaining required accuracy in machined parts from man power to machine tools for the first time in industrial history.

Other automobile makers rapidly followed the course thus charted for them, and soon other lines of manufacture did likewise. The motive in all cases was to make a product of better quality at a lower selling price, and thus to increase sales. This has actually been accomplished, and society as a whole is the gainer. It is unfortunate that some men have been deprived of their jobs, but such is the price of progress. Since the invention of the type-setting machine forced unemployment on thousands of printers there has been a long succession of mechanical achievements that have dealt unkindly with a few while benefiting many. From all indications, the necessity for adjustment between man power and machines will recur periodically as long as the present order of society exists. This condition does not result from any desire of management to oppress labor, but is rather a consequence of the will of the world to progress.

It is debatable, of course, whether machines, in the aggregate, actually make for less labor. It requires men to manufacture machines, and the displacement of labor in a plant that adds machinery is at least partially compensated for by the additional jobs created in the plant that produces that machinery.

## RAND GOLD OUTPUT

**S**OUTH AFRICA continues well in the vanguard of the gold-producing countries, and each succeeding month sees new records made on the Witwatersrand. The output in July was 997,013 ounces, worth \$34,895,455. This was the highest monthly mark ever attained, the next best having been registered in September, 1932. Production for the first seven months of 1937 aggregated 6,811,686 ounces, valued at \$238,409,010. If the prevailing rate is maintained through December, the year's output will exceed the 1936 total by 340,000 ounces, which is equivalent to \$11,900,000.

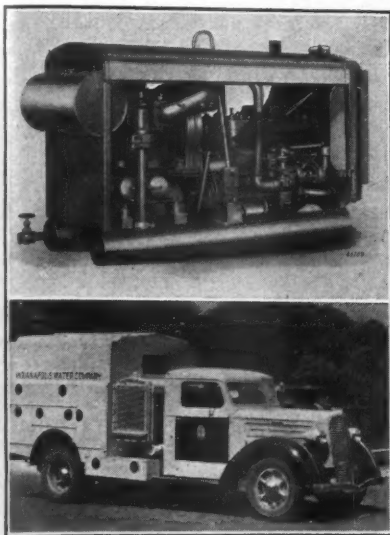
The mines are divided into the two classifications of large and small, based on their production. The 48 large properties accounted for more than 98 per cent of the output in July, the remaining less than 2 per cent was obtained from 73 properties.

Along with the mounting production there is a steady reduction in the average value of the ore, the yield per ton having dropped from \$8.55 in June to \$8.50 in July—the recovery per ton for the first six months of 1937 averaging \$8.94. The decreased value is attributable to the mining of increasing quantities of leaner ores along with the richer ones, the total amount crushed by the larger mines in July having set a new high record of 4,249,576 tons. The grade of ore produced in July by eighteen of the larger mines was well below \$8 a ton.

The average number of rock drills in use during July in producing mines was 7,586. Thus each drill accounted for 573 tons of ore from which there was recovered gold worth \$4,600. On this basis, the annual yield per drill is more than \$55,000. In addition, 424 rock drills were in service during July in nonproducing mines.

Further evidence of the enormous scale of the gold-mining activity on the Rand is that during 1936 development work in producing mines aggregated 2,000,000 feet. Of this total some 1,300,000 feet was in reef or vein material, and the remainder was "dead" work.

## Compressor for Truck Mounting



trol that takes current from the truck battery.

With air at 100 pounds pressure, the compressor has a capacity of 85 cfm., which is sufficient for the operation of two paving breakers or of one paving breaker and one No. 45 Jackhammer. The air is delivered to two receivers that serve at the same time as a foundation for the portable. These receivers have a combined capacity

of  $2\frac{1}{4}$  cubic feet. Compact and self-contained, the U-85 Utility compressor can be easily transferred from one truck to another or placed on the ground, if desired, by means of the sturdy lifting bale with which it is provided. Full information regarding this machine is contained in Bulletin No. 2320-A, which can be obtained by addressing a request to the company at 11 Broadway, New York, N. Y.

## Chemicals Solidify Unstable Soils

**A** GERMAN invention of considerable interest to the ammonia-soda industry has been reported by the American Consulate General at Frankfort. It concerns the use of calcium chloride—a by-product of that industry—and sodium silicate for cementing shifting sand under building foundations. According to that authority, a concentrated solution of sodium silicate is forced underground through numerous pipes and carried down to the stratum to be made impervious. This is followed by a solution of calcium chloride. A chemical reaction immediately sets up, resulting in the formation of a gel that binds the sand into a mass similar to sandstone. The process is applicable to both wet and dry formations, but they must be of sufficient porosity to permit rapid penetration by the chemicals. It has been tried in the case of a number of large construction projects, and is considered of such importance by the

Solvay Works at Bernburg that it has decided to build a new calcium-chloride factory with a capacity of 6,000 tons a month.

This is in striking contrast to the past when the Bernburg Works experienced considerable difficulty in disposing of the immense quantities of calcium chloride that were obtained as a by-product. For a time it was emptied into the Saale. When this practice had to be abandoned because of the complaints of local fishermen, the waste liquid was pumped on to the tops of nearby hills where it was allowed to evaporate, forming extensive layers of calcium chloride in the course of time. About three years ago those deposits started creeping, eventually reaching the Saale and obstructing the flow of that stream for a distance of approximately 1,650 feet. The story today is a different one, thanks to chemical research.

**F**OR the convenience of the maintenance departments of public utilities, Ingersoll-Rand Company has designed a 2-stage, air-cooled portable compressor for truck mounting. The Model U-85, as it is designated, is 2 feet  $3\frac{1}{2}$  inches wide and has an over-all length of 6 feet  $7\frac{1}{2}$  inches, which permits placing it crosswise, leaving ample space for the men, tools, and other equipment that must be carried. It is driven independently of the truck motor and the transmission by a built-in 4-cylinder, 4-cycle Waukesha engine that is started by an electric motor with push-button con-

## Truck That Helps to Load and Unload Itself

**T**RUCK bodies with floors that are virtually belt conveyors have been introduced by the Easton Car & Construction Company to assist in loading and unloading bulk and other materials, heavy machinery, bagged and boxed goods, in fact most anything that has to be trucked from one point to another. The floor, or Loryflor as it is called, consists of a single sheet of very durable cord-rubber belting that travels over steel rollers as it is wound back and forth from one end roller to the other in discharging and taking on loads. The reeling is done by means of cranks turned by hand from either side or end of the truck, and calls for little effort on the part of the operator regardless of the weight or character of the load. As he has the movement of the belt under his control all the while, it is possible to clear the floor of sand, coal, or any other loose material in a few seconds or, in the case of machinery or packed goods, to ease them on or off as carefully as necessary.

The accompanying picture shows a truck with a Loryflor body that is used by a foundry to do all its hauling of ingots, castings, the raw materials required for their production, and the incidental waste. It is provided with side and end gates; is approximately 12 feet long, 6.5 feet wide, and 1.5 feet deep, inside dimensions; and

has a pay-load capacity (water level) of 4.5 cubic yards. By shortening the stops at the loading and unloading points, it can make more trips in a given length of time than an ordinary vehicle of this type, and therefore has saved the expense of another truck that would otherwise have

been required by the foundry to meet its varied transportation needs.

The Easton Car & Construction Company is prepared to supply complete Loryflor truck bodies ready for mounting, or to make movable floors for trucks of special manufacture and size.



## Industrial Notes

With the formal opening on September 16 of the suspension bridge across Tamaulapa River in Guatemala, there was added another link in the Inter-American Highway. The steel used in the construction of this span was a gift of the United States Government, which also supervised its erection.

Japan is contemplating the construction of a subaqueous tunnel to Korea by way of Tsushima Island and Kyosai Island. As planned, it will be approximately 160 miles long and lie 164 feet below sea level. The project is said to be feasible; and at least ten years would be required for its completion.

Peat is being used in Germany as a substitute for jute, cork, or infusorial silica in the making of a heat-insulating material for piping. It comes in the form of rope having a diameter ranging from  $\frac{3}{4}$  inch to  $1\frac{1}{2}$  inches, weighs about 5 pounds per cubic foot, and is laid in wire nets. It is said to be giving satisfactory service; but, no doubt, conservation dictated the change.

Metal parts that have been dropped into an engine crankcase, transmission, or differential, or that have found their way into a machine or piece of equipment, can, if in no other way, be retrieved by Pick-Em-Up, a tool made by the Lodi Company. It has a long flexible rod of insulated wire protected by spring wire, and is magnetized when a switch on its handle is pressed. Direct current at 6 volts is used to operate this handy device.

Some of the more unusual applications of sanding papers and cloths, as listed by the Norton Company, are: Keeping tension on silk threads in silk mills; buffing imitation leathers to produce a suede finish; finishing wood heels of womens' shoes; removing fins and molding flash from the edges of composition buttons; scarifying certain seeds to make them sprout more readily; and removing the brown skin jackets from peanuts.

Leadleaf is the name of a new metallic lead pigment which is recommended by the manufacturer especially for the painting of bridges, water towers, and steel structures generally, as a priming coat on steel, and as a seal coat on concrete. It can also be used it is said to protect wood surfaces exposed to gases and acid fumes. The product is a fine powder which comes in paste form ready for mixing and application by brush or air spray.

The largest icebreaker yet to be constructed, the *Joseph Stalin*, is on the ways in Leningrad, Russia. It will have a displacement of 11,000 tons, will be 348 feet long, and will be driven by three steam engines having a combined capacity of 10,

050 hp. The hull will be reinforced with steel ribs set one foot apart throughout the entire length of the ship. Those parts that will take the impact of the ice will be sheathed with steel plates two inches thick.

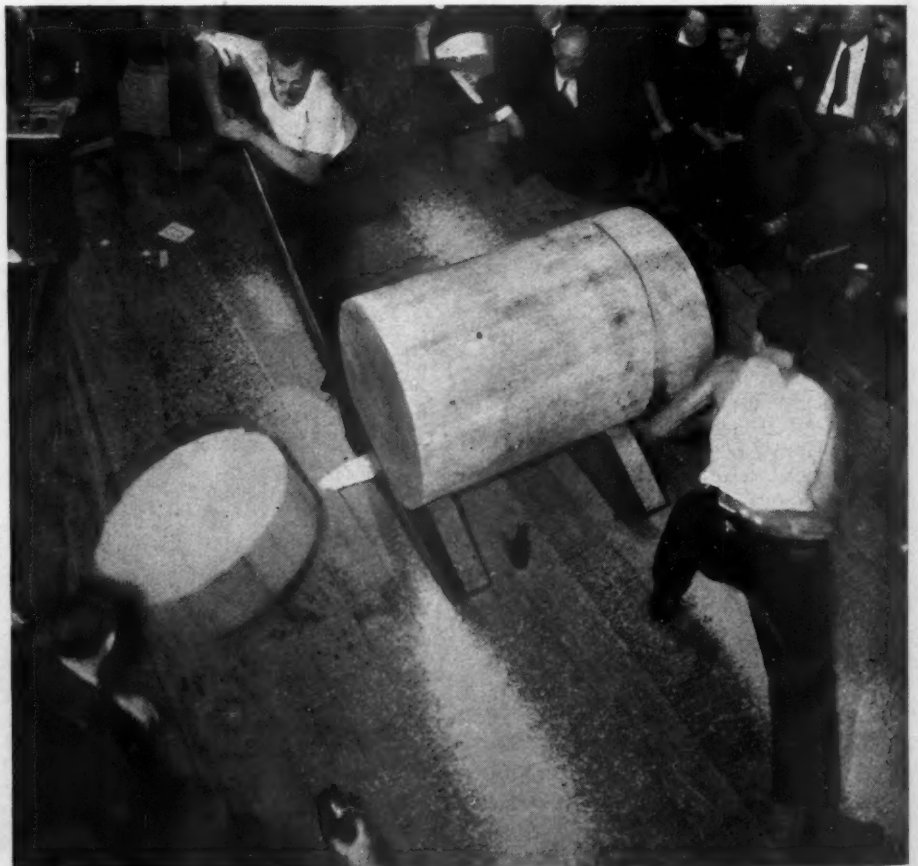
Seamless-steel tubing combining light weight with exceptional rigidity is being made of narrow strips helically wound and lock-seamed together. In the case of a 6-inch-diameter tube of this description the material used is only twelve-thousandths of an inch thick. The lock seams act as stiffeners and are on the outside, leaving the inner walls smooth. Such tubing has many potential applications and could, for example, serve to protect the standard terra-cotta linings of chimneys against the corrosive action of flue gases.

The mining interests of the country will sponsor a working display at the 1938 Golden Gate International Exposition to acquaint the general public with mining procedure. A miniature mine will be constructed, with several levels and having a shaft,

drifts, and stopes with complete equipment for actual mining operations. Visitors will be enabled to go underground and there witness how ore is extracted. In conjunction with the mine, there will be exhibits to demonstrate the milling of ores. The complete display, to be known as Treasure Mountain, will be 280 feet long and 50 feet high.

One of the largest lumbering concerns in the West has found a way to convert the bark of the redwood, a hitherto waste product, into a marketable commodity. The bark of that tree is very tough, and as no saw cuts it, it has to be stripped from the logs before they go to the mill. In consequence, huge piles have accumulated in the forests because the disposal of the refuse by burning has not been practicable.

At its mill in Scotia, Calif., the Pacific Lumber Company has built a bark-peeling plant, together with shredders and driers that are much like those used in preparing raw materials for manufacture into textiles. There the bark is processed by first tearing



### CHAMPION SAWYERS IN ACTION

Despite mechanization programs, physical strength and skill are still big factors in many industries, and topnotch workmen perform almost incredible feats in special lines of activity. In the logging industry, men are still men when it comes to wielding saws and axes, and even Paul Bunyan, the legendary patron saint of timbermen, might have a word of praise for their accomplishments. One of the highlights of the Pacific Logging Congress each year is the competition for the world log-bucking championship. The picture shows Paul Searls of Longview, Wash., successfully defending his championship laurels at last year's meet against Allen Heyd of Duncan, B. C. Using a Disston bucking saw, weighing slightly less than 11 pounds, Searls cut through a 32-inch log of Douglas fir in 2 minutes and 57.1 seconds.

it into bits in the shredders and then passing it through a series of willowing and condensing machines where all dust and solid matter are removed. From there it issues in the form of a soft fluffy wool, red in color, that is a good insulating material. It is being utilized as such in fur vaults, cold-storage plants, in the construction of houses, in electric water heaters and air-conditioning auxiliaries, etc. As a filler under layers of cinders and clay it makes running tracks more resilient, to the greater comfort of sprinters.

An interesting development in pneumatic caissons is reported from Russia. A Soviet engineer has, according to *Construction Abroad*—which is published by the U. S. Department of Commerce—designed a caisson in which the excavating is done mechanically. He achieves this by the use of heavy-duty pumps: one inside the caisson to reduce the mud or sand to a fluid state, and others to withdraw the mixture. It is said that several caissons of this type have been built and used with successful results.

London is considering the construction of a dam across the Thames River below the city to eliminate tidal action. The proposed structure, which was first suggested in 1858, would create a lake 29 miles long. The dam would be surmounted by a vehicular and railroad bridge and would contain six locks of various sizes to permit the passage of vessels up and downstream. The dam would be 1,500 feet in length, 60 feet in maximum height, and would cost around \$22,000,000.

Voters of Missouri will decide by ballot whether an increase in the state gasoline tax from two to three cents a gallon is to remain in force. The rise was put in effect by the legislature last spring, but opposed interests took advantage of a provision in the Missouri constitution which permits controversial legislative acts to be referred to the people. To insure a vote, 65,000 signatures of qualified electors were required. Circulators of the referendum petition secured 163,000 signers in less than 30 days. Voting cannot take place until the next general election in November, 1938.

*Heat and Its Control* is the title of a talking motion picture that has been produced by Johns-Manville and is based on that company's more than 75 years of experience in the art and science of heat conservation. The film tells the story of heat from the time man worshipped the sun down to today, showing, among other things, the development of the steam engine, the discovery of the true nature of heat, and the present methods of developing and manufacturing materials designed for the conservation of heat. Engineering societies and other interested groups can arrange with Johns-Manville district organizations for showings of this picture.

# Cosmetics



## ... and the complexion you flatter

OUR APOLOGIES to the ladies—but it's the cruel truth that today we men are very knowing about complexions. Even while we breathe flatteries, we know the lady has been flattered before we spoke—by her cosmetics.

To complete your disillusion—the ladies are now being assisted by that most masculine of products—stainless steel! Yes, sir, Lebanon Circle L Stainless Steel Castings have a hand in that rosy flush and satiny texture—and we're proud to announce it.

Just recently, one of America's greatest manufacturers of cosmetics asked Alloy Steel Products Company for really fine plug cocks. Alloy Steel Products

specified castings of "Circle L" Stainless Steels. For in superlative cosmetics there must be no possibility of contamination through corrosive action. So, to eliminate all chance of corrosion, Circle L Stainless Steel Castings have been given the call.

### NOT SELLING COMPLEXIONS?

Perhaps you are not concerned with complexions. But you ARE concerned with profits—and corrosion is their enemy. The example of this glorifier of beauty is one that you might well follow, however remote lotion cream and rouge may seem from your industry. Talk it over with a helpful Lebanon expert.

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Cameron pumps are available for general refinery service, including main water supply, cold water circulation, boiler feed, etc.

The famous XVG gas-engine-driven compressor has proved to be the solution to many problems which have confronted refinery men the world over. The complete I-R compressor line includes over 1,000 sizes and types, making it possible to select a machine that is exactly suited to any set of conditions.

The I-R Impact Wrench is the ideal tool for maintenance and repair work in refineries. Three sizes are available—the large 57-pound wrench being able to successfully remove or apply nuts, cap screws and set screws up to 2 1/4". This pneumatic marvel will pay for itself in a surprisingly short time.

*"Other I-R products for refinery service are vacuum pumps, condensers, ejectors, diesel engines and a complete line of pneumatic tools."*

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Two four-cylinder gas-engine-driven XVG compressors in the Wood River Refinery of the Shell Petroleum Corporation.

A size 555 Impact wrench tightening header plate on reaction chambers of cross still. "Only licensee of Pott Patents Nos. 2,012,916 and 2,049,273."

24 single and two-stage Cameron refinery pumps installed in a large stabilizer plant.

A battery of 9 Cameron two-stage centrifugal solvent pumps in a large Duo Sol Plant.